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MATHEMATICAL CONSTRUCTION

LAFFIN

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MATHEMATICAL CONSTRUCTION

INFORMAL NUMBER WORK FOR BUSY HANDS

GRADES ONE AND TWO

BY

N. LOUISE LAFFIN

OF THE CHICAGO SCHOOLS

A. FLANAGAN COMPANY

CHICAGO

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MATHEMATICAL CONSTRUCTION

INTRODUCTION

All the construction work should be carefully selected by the teacher with a two-fold purpose.

1st. The appropriateness of the thing itself to the child's need; a co-relation to other studies, or a gift, plaything or actual necessity.

2nd. The appropriateness of the number relations to the child's mathematical discoveries; a proper sequence from the simplest of mathematical relations to the more complex, and a proper order of inferences.

The possible number relations found in the process of the construction of an article should be brought out carefully by the teacher. While the child is making something he is in a receptive mood for this number work. Each step gives new surfaces or lines to compare.

When the teacher artfully questions, giving concrete problems regarding these ever changing lines and surfaces, she gets answers from alert minds; minds that are comparing and coming to conclusions then and there; minds that are not trying to remember what the teacher said yesterday or a week ago; minds that are seeing and drawing inferences at the present moment.

In applying number work to the making of things in the

first and second grades (by folding, free cutting or measuring), a teacher should let the child judge the relations of things himself. By repeated acts of judgment he gains the power to see relations correctly.

Indefinite relations are seen before the definite. Therefore, the earliest lessons (found in the folding of articles) should deal only with words which express contrast; such as larger and smaller, longer and shorter, more or less. A few weeks of this indefinite relation work usually suffice. Then follow the relations, 1, 2, 3, 4, equal $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$. In these lessons the teacher should only show the fold, the child imitating. This gives mental training through sight. After the child has imitated the teacher's silent direction, the teacher should ask questions bringing out the relations (indefinite or definite as the state of the child's mind permits).

These questions should introduce technical words incidentally and informally to the pupil. By giving little concrete problems based on the relation of surfaces, lines and solids, she can do this. For instance: when a square is folded into equal oblongs she may say, "If this oblong is enough cloth (pointing to one oblong) for one doll's dress, what is this oblong?" (pointing to other). Or, "Play this oblong is a dresser scarf, which has lace all around it. If the lace on the upper edge costs a dime, what does the lace on the side edge cost?" Ans. "More than a dime." Child gets words oblong, upper edge, lower edge incidentally.

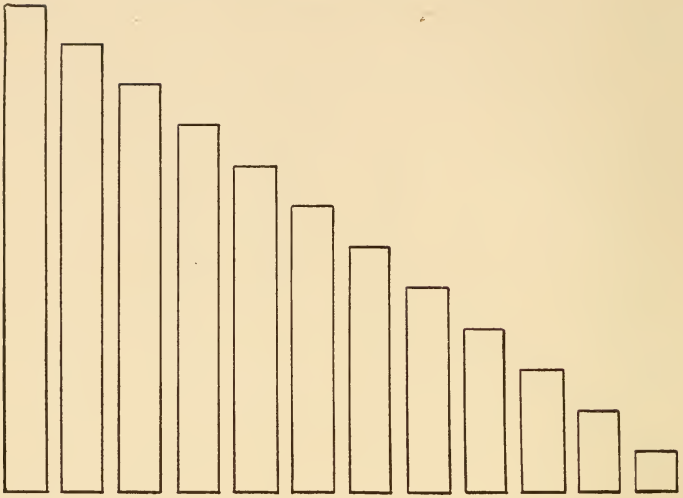
Giving concrete problems in this way is interesting to the imaginative mind of a child. He plays that sand is sugar, buttons are money, and stones are potatoes or apples. Why can't he play that oblongs or squares are parks, play-

grounds, ceilings, bed quilts, tablecloths, articles of clothing, etc.?

And why can't he also play that two of those are two parks, or three of them are three parks? If one park contains five acres, two parks contain two five acres, etc. Why can't he play that a triangle is: a doll's shawl, a pond of ice to skate on, a tile, a piece of glass, the leather corner of a desk blotter, etc.? Why can't he play that edges require fringe for rugs, bedspreads, napkins, doilies, the top of a carriage, etc.; fences for parks, farms, yards, empty lots, etc.; binding for slates, books, pictures, cloth; curbstones for streets; hedges or trees in a row for yards, parks, roads?

When the children are familiar with the technical words, the teacher should give verbal directions instead of silently showing them, thus giving child mental training through hearing. These verbal directions are more difficult than the sight directions, for they involve a memory of the technical words and number relations learned incidentally through the concrete problem work.

After a child can fold, by following the verbal directions of the teacher, he is ready to use a ruler. An ordinary 12-inch ruler is beyond the comprehension of the beginner. The inch is within the 2-inch measure, and within the 3-inch unit there is the 2-inch and also the 1-inch unit. The child cannot see the relation of 1 inch to 2 inches on the ruler; therefore, he should use *single* unit rulers. A teacher should have a complete set for each child in the room. A set consists of 12 pieces of strong, tough, smooth cardboard (pressboard is the proper name). Each piece is 1 inch wide, and respectively, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12 inches long.



Of course the child is not given the whole set at once. He would be confused.

If the teacher intends making something which requires a 6-inch square, for instance, she gives him a 6-inch ruler. If that must be bisected he is given a 3-inch ruler. If the original paper is 9″x12″ let him estimate the width of it. He will tell you that the width is

the sum of 3″ and 6″ or
the sum of 6″ and ½ of 6″ or
three 3″

He will say that the length is:

four 3″ or
the sum of 6″ and 6″ or
the sum of 6″ and 3″ and 3″ or
the sum of three 3″ and ½ of 6″

With these rulers one obtains mathematical relations of the measures which one could never get from little children with the ordinary ruler, which has the units within many other units. The children see:

the sum of 3″ and 3″,
the difference between 6″ and 3″,
the division of 6″x2,
the multiplication of 3″x2.

When in a later lesson the 9-inch ruler is introduced, the children see:

6″ 3′3″=9″ $\frac{1}{3}$ of 9″=3″
3″
—
9″

9″ 9″
-6″ -3″
— —
3″ 6″

In making an article based on a square consisting of 16 squares, we use the dimensions:

3, 6, 9, 12, or
2, 4, 6, 8, or
1, 2, 3, 4.

Why should a child be bothered with all the units within units of an ordinary ruler when he can be given something which is definite to him? How easy it is to see that 6 is $\frac{1}{2}$ of 12; 3 is $\frac{1}{4}$ of it, etc., with these distinct units of measure.

The making of an article based on a square consisting of 9 squares vividly shows the relation of 1, 2, 3; 2, 4, 6; 3, 6, 9; 4, 8, 12.

One based on a square consisting of 4 squares gives the relations 1, 2; 2, 4; 3, 6; 4, 8; 5, 10; 6, 12.

The first step in the using of the ruler is like the first step in folding. The teacher should show the direction and the child imitate (sight and mind training). The only verbal expression of the teacher is the naming of the ruler, viz.: "This is a 6-inch ruler."

The second point in the use of the ruler is that the teacher directs verbally, after the child has learned how to use it.

Third point: Child must do mental addition, subtraction, division, or multiplication, by following teacher's verbal direction.

Teacher asks questions like these:

(Suppose child to have rulers 3″, 6″, 9″, 12″ long, and that he is familiar with their relations through former work in measuring, and that he has paper 9″x12″.)

Show me the edge that is three 3″ long.

How many inches long is it?

Show me the edge that is the sum of 9″ and 3″ long.

How many inches long is it?

On the upper long edge mark off $\frac{1}{2}$ of 12″. One-half of 12″ is how many inches?

If it costs $12.00 to build a fence on this edge (pointing to the 12-inch edge) what part of $12.00 will it cost to build a fence on this part (showing 6″) of it? Ans. $\frac{1}{2}$ of $12.00.

How much money will it cost? ($6.00) Etc.

This last question relative to cost is an inference. From actually seeing that 6″ are $\frac{1}{2}$ of 12″ the child easily infers that $6.00 are $\frac{1}{2}$ of $12.00. If questions were asked concerning time required to build the fence it would be easy for the child to infer that 6 days are $\frac{1}{2}$ of 12 days;

6 hours are $\frac{1}{2}$ of 12 hours;
6 men are $\frac{1}{2}$ of 12 men.

So all possible combinations, separations, products and parts of the numbers to 12 can be reached through the use of these rulers.

When a child has seen that the sum of 3″+3″=6″ and has inferred that

3c and 3c = 6c; or
3 yds. and 3 yds. = 6 yds.;
3 hours and 3 hours = 6 hours;

the teacher should go to the board and write

$$\begin{array}{r} 3 \\ 3 \\ \hline 6 \end{array}$$

At some other time, other than the construction period, have a drill on writing the combination. Write it as a whole. Erase and let them write it. Write it again omitting one of the numbers. Erase. Let children write it inserting the one the teacher omitted, etc.

Drills of this sort help to fix number relations which have been previously seen.

MATHEMATICAL CONSTRUCTION

PLAN OF THE LESSONS

Folding

I have in the *folding lessons* shown what variety of concrete problems can be given; how many of them can be correlated to the finished article; how they do incidentally show the number relations 1, 2, 3, 4 and more, equal, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$.

At the end of some of the simple folding lessons, I have drawn surfaces which the child sees in making the article. These can be put on the blackboard and concrete problems based on them after the folding lesson.

Folding and Free Cutting
(Weaving and Decorating)

After a child has dealt with the relations 1, 2, 3, 4, equal, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$ in folding lessons, he is ready to do some free cutting.

Weaving and Decorating give many opportunities for cutting a piece of paper into 2 equal pieces, or 3, or 4, as the case may be; or, for cutting a piece of paper twice as large, long, or wide as another.

There is a natural sequence of the three topics *folding, free cutting* and *measuring* in the single subject *Weaving.* The weaving lessons are presented in this order. No concrete

problems have been written in connection with these lessons, but they should be given wherever there are surfaces or lines to compare.

These woven mats can be utilized in many ways. They can be used in the doll house for mats, table cloths, dresser scarfs, sofa-pillow tops; they make a good background for wall-pockets, calendars, match scratchers; woven a certain way they make telephone pads; they also make a pretty top for blotters, or outer side of napkin rings when they are under transparent celluloid. Wall paper can sometimes be made by weaving. Woven mats can be folded and pasted into cornucopias, lanterns, and all sorts of baskets. They can be used to decorate books, outside of banks, envelopes, etc.

In the folding and free cutting weaving lessons, the development of the relations 1, 2, 3, 4, has been shown.

In the measuring lessons, besides showing how naturally and definitely number relations are felt in using these single unit rulers, a utility has been given for every mat. For progressive number work, however, carefully read the lessons given under the heading *"Measuring* with *Single Unit Rulers."*

Measuring with Single Unit Rulers

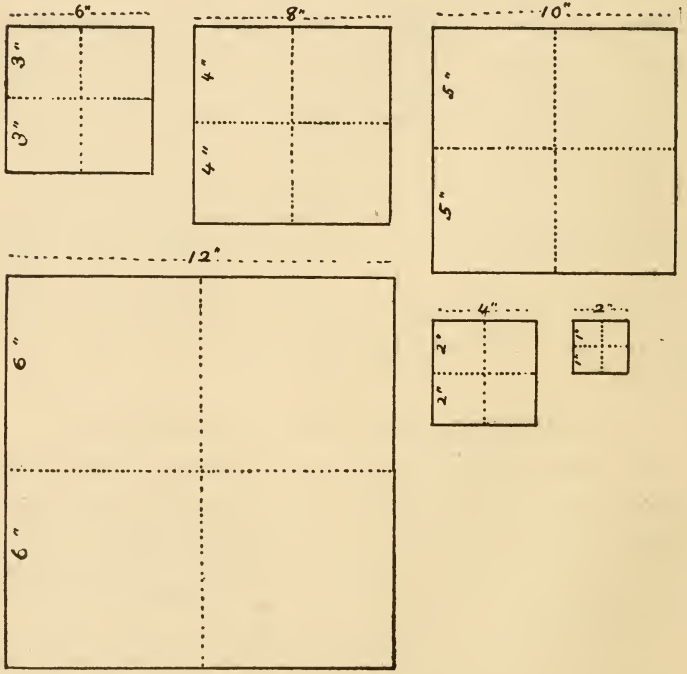
In *measuring* with the *Single Unit Rulers,* I have shown how, through a series of lessons, the child finds all combinations, separations, products, and parts of numbers up to 12; also the great variety of lines, surfaces and solids there are to compare; how I correlate my concrete problems with the finished article.

There is such a great variety of these surfaces and lines that the teacher must discriminate in comparing them. She

must not ask questions on every possible relation she sees; if she stops too often the child will lose interest in what he is making. That is worse than losing the number work.

In making an article based on a square consisting of 4 small squares, the child sees the relation of

1 to 2; 2 to 4; 3 to 6; 4 to 8; 5 to 10; or 6 to 12.



From these squares the following articles can be made:

Booklet.	Picture frame.
Wall-pocket.	Salt and peppers.
Soldier's cap.	Boat.
Bookmark.	Basket.
Fireman's cap.	Cup.

Scissors holder.

In making an article based on a square consisting of 9 small squares, the child sees the relations of 1, 2, 3; 2, 4, 6; 3, 6, 9; or 4, 8, 12. From 9 squares the following can be made:

Taboret.	Dutch bonnet.
Stove.	Wheel-barrow.
Cube bank.	Box.

Baskets (cut on straight folds or cut on diagonals).

In making an article based on a square consisting of 16 small squares, the child observes the relations of 1, 2, 3, 4; 2, 4, 6, 8; or 3, 6, 9, 12. From 16 squares the following can be made:

Baskets (cut on straight fold, or cut on diagonal).

Cradle.	Hallowe'en lantern.
Table.	Pilgrim cradle.
Chair.	Square prism.
Lounge.	Square pyramid.
Bed.	Cube.
House.	Wagons and carts of all kinds.
Wood box.	Sled.
Box with lid.	Pocket-book.

Dresser, sectional book case, or any kind of cabinet with drawers or compartments.

Then there are all sorts of odd lengths and widths of oblongs to be used as sides for circular baskets, pails, bowls; backgrounds for calendars, match scratchers, wall-pockets; strips and mats for weaving. These give such combinations as:

2	3	5	9	7	
3	4	4	2	3	
5	7	9	11	10	etc.

The following chart shows every combination of numbers from 1 to 12 inclusive, and the lessons in which the child sees these combinations:

ALL THE COMBINATIONS TO 12 AND THE LESSONS IN WHICH THEY ARE FOUND

NOTE.—These are in the measuring section unless otherwise specified.

1
1
—
2

Lessons: XIV, XVII, XX, XXII, XXVII.

2
1
—
3

Lessons: XIV, XVII, XIX, XXII, XXV, XXVII, XXIX.

3
1
—
4 Lessons: VI, XIV, XVII, XVIII, XXVII, VIII, (Weaving, p. 78), II (Weaving, p. 69), XXIX.

4
1
—
5 Lessons: XXX, XXI, XXVII, XXIX.

5
1
—
6 Lessons: XXX, X, XXIV, VII (Weaving, p. 76).

6
1
—
7 Lessons: XXIV, XXXVII.

7
1
—
8 Lessons: II (Weaving, p. 69), VIII (Weaving, p. 78).

8
1
—
9 Lesson: XXXV.

9 Lessons: XXXII, VII (Weaving, p. 76).
1
—
10

10 Lesson: VII (Weaving, p. 76).
1
—
11

11 Lesson: XXXV.
1
—
12

2 Lessons: IV, XIII, XVI, XXVII, XXXI, VII, XIV,
2 XVII, XXVIII, XXXIV.
—
4

3 Lessons: V, XXVI, XXVII, XXIX.
2
—
5

4 Lessons: XXX, VII, XIII, XVI, XXVIII, XXXI,
2 XXXIV, VI (Weaving, p. 74).
—
6

5 Lessons: XXX, X, XXXIII.
2
—
7

6 Lessons: XIII, XVI, XXVIII, XXXI, XXXIV.
2
—
8

7 Lesson: XXX.
2
—
9

8 Lessons: XXXI, XXXIII, XXXIV, VI (Weaving, p.
2 74).
—
10

9 Lesson: VII (Weaving, p. 76).
2
—
11

10 Lessons: XXXIV, XXXV.
2
—
12

3 Lessons: III, VIII, XII, XXVIII, XXXIII, XXXVI.
3
—
6

4 Lessons: VI, VIII (Weaving, p. 78), II (Weaving p.
3 69).
—
7

5 Lesson: XI.
3
—
8

6 Lessons: VIII, XII, XV, XXV, XXVIII, XXXIII,
3 XXXVI.
—
9

7 Lessons: VI (Weaving, p. 74), VIII (Weaving, p.
3 78).
—
10

8 Lesson: VIII (Weaving p. 78).
3
—
11

9 Lessons: XII, XV, XXVIII, XXXIII.
3
—
12

4 Lessons: IX, XIII, XVI, XXVIII, XXXI, XXXIV,
4 XXXV.
—
8

5 Lessons: XXX, XXI, XXXII, XXXV.
4
—
9

6 Lessons: XXXI, XXXIV, VI (Weaving, p. 74).
4
—
10

7 Lessons: VIII (Weaving, p. 78).
4
—
11

8 Lessons: IX, XXVIII, XXXIV.
4
—
12

5 Lessons: XXVI, VII (Weaving, p. 76).
5
—
10

6 Lesson: VII (Weaving, p. 76).
5
—
11

7 Lesson: X.
5
—
12

6 Lessons: XII, XV, XXVIII, XXXIII, XXXIV.
6
—
12

2, 1″—XIV, XVII, XXIX.
2, 2″—IV, VII, XIII, XIV, XVI, XVII, XXVIII, XXIX, XXXI, XXXIV.
2, 3″—III, VIII, XII, XV, XXV, XXVI, XXVIII. XXXIII.
2, 4″—II, IX, XIII, XVI, XXVIII, XXXI, XXXIV.
2, 5″—XXVI, XXXV.
2, 6″—XII, XV, XXVIII, XXXIII, XXXIV.
3, 1″—XIV, XXXVI.
3, 2″—VII, XIII, XVI, XXV, XXVI, XXVIII, XXXI, XXXIV.
3, 3″—VIII, XII, XV, XXII, XXV, XXVIII, XXXIII.
3, 4″—IX, XVIII, XXVIII, XXXII, XXXIV.
4, 1″—XIV, XVII.
4, 2″—XIII, XVI, XXVIII, XXXI, XXXIV.
4, 3″—XII, XV, XVIII, XIX, XXVIII, XXXIII.
5, 1″—XXIX, XXIV, XXVII.
5, 2″—XXVI, XXXIV, XXXV.
6, 1″—XXXVI.
6, 2″—X, XIX, XXVIII, XXXIV.

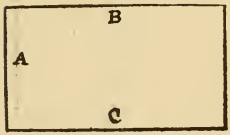
FOLDING

LESSON I

Shawl

Note.—Early lessons should be given without verbal command. Teacher should only show what to do. Then let children imitate.

Material: An oblong piece of paper.



Give word oblong in this way:
Show me a long edge of this oblong.
Show me a short edge of this oblong.
Show me an edge longer than *a*.
Show me an edge shorter than *b*.
Show me an edge shorter than *c*, etc.

Play the oblong is a shawl.

Which edge needs more fringe, *a* or *b*? (Teacher points to edges.)

If the fringe on *a* costs a nickel, what does the fringe on *b* cost? (Ans. More than a nickel.)

If the fringe on *b* costs a nickel, what does the fringe on *a* cost? (Ans. Less than a nickel.)

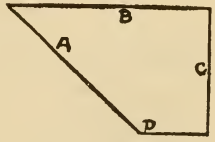


Fig. 2.

Teacher folds so that the edge *a* exactly touches *b*. Children imitate.

Result: Figure 2.

Children lay theirs on desks. Teacher shows large undivided surface to them. Play that it is a piece of cloth and

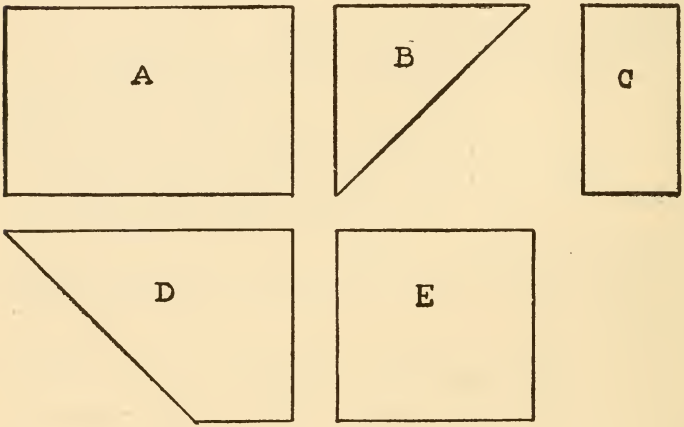
repeat questions on relations of surfaces as before. Viz.: If it takes an hour to hem this side (pointing to *d*) will it take more or less to hem this (pointing to *c*)? Ans. More than an hour, etc.

Fold back oblong and tear off.

Result: A doll's shawl.

Surface Seen While Making Shawl

Draw them on the blackboard to scale of 6″ to 1″.



Suggestive comparisons on which to base problems:

A=3 of C.
=3 of B.
=sum of B+E.
=sum of D+B.
=sum of E+C.
=sum of D+C.

E=2 of C.
=2 of B.
=D.
=sum of B+C.

B=½ of E.
=½ of D.
=⅓ of A.

D=2 of B.
=2 of C.
=E.
=A–B.
=sum of B+C.

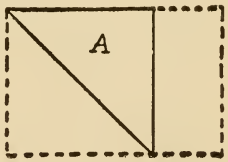
NOTE.—If child does not see the relations of the surfaces, cut pieces of paper the exact size of the blackboard figures. Dissect and put the pieces together in any necessary form to give the child a clear image of the relation of the surfaces.

LESSON II

BOOKLET

Repeat lesson *I* but speak of the oblong being a cover for the library table, the edges of which are stenciled, hemmed, embroidered or fringed.

When *A* is obtained the children have 2 surfaces each a triangle. Play one triangle is a library floor, what is opposite surface? (Ans. Another floor just as big.)

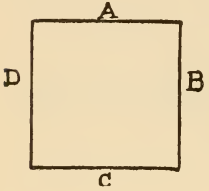


If it takes 10 yds. of carpet for the first floor, how many yds. for opposite floor? The teacher just points to the surfaces saying: If it takes 10 yds. for this floor, how many for this? (Ans. Just as many, 10 yds.) If this costs $25.00, what does this one cost? etc.

Unfold the paper. Result: A square.

Play this is a rug for the library.

If the fringe on *A* costs a dollar, what does the fringe on *C* cost? on *D*? on *B*? How many dollars for fringe on *A* and *C* together? *D* and *B* together? How many dollars for all sides?



Fold the square into 2 equal oblongs. Here are two oblong surfaces to compare as the triangles were compared.

Result: A booklet.

LESSON III

Wall-pocket

(New relation 1 to 2)

From an oblong proceed to make a square as in previous lessons, but do not ask too many questions on the surfaces and lines already talked about. The same relations with different lengths of lines and size of surfaces can be found in the new folds.

After the square has been folded into 2 equal oblongs the new folds begin.

Fold so that the short edges touch.

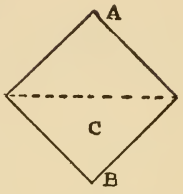
Result, 4 small squares. Children see only the outside ones.

Teacher points to 1 square and says: If this window glass costs a dime, what does this one cost? (Pointing to opposite one.) (Ans. One dime.)

If it costs a quarter? (Ans. One quarter.)

If putty on one edge costs a penny, what does putty on another cost? What does putty on all cost?

Hold square so that 4 free points point upward. Teacher moves one point from *A* to *B*, thus making a wall-pocket.



Now child sees a whole triangular surface (*C*) and the opposite side which is a square.

Now play *C* is a piece of glass for a window. Teacher points to opposite surface (the square) and says: How many pieces just as big can be cut from this? (Ans. 2 pieces of glass.) If this (pointing to *C*) costs a nickel, what does this (pointing to opposite square) cost? (Ans. 2 nickels.)

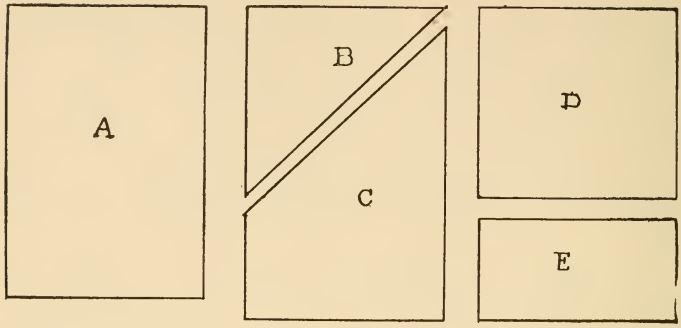
If it costs a dime? (Ans. 2 dimes.)

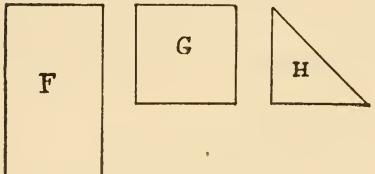
If it costs a quarter? (Ans. 2 quarters), etc.

Suggestive Comparisons of Surfaces Seen While Making Wall-pocket

Draw surfaces on blackboard to any scale large enough to be easily seen by pupils. Base problems on these surfaces.

A=sum of B+C.
=sum of D+E.
=3 E's.
=3 F's
=3 B's.
=6 G's.
B=$\frac{1}{3}$ of A.
=$\frac{1}{2}$ of C.
=4 H's.
=$\frac{1}{2}$ of D
=E
=2 G's
G=2 H's.
=$\frac{1}{2}$ of F.
=$\frac{1}{2}$ of B.
=$\frac{1}{4}$ of D.
=$\frac{1}{4}$ of C.
=$\frac{1}{6}$ of A.
F=2 G's.
=4 H's.





E=C–B.
=2 G's.
=$\frac{1}{3}$ of A.
=$\frac{1}{2}$ of D, etc.

LESSON IV

Soldier's Cap

Made just like wall-pocket with an additional fold at the end; the folding back of the three points which were left as the back of the wall-pocket. Result: Soldier's cap.

Number relations not different than Lesson III; but this should be made of a differently sized paper, to give a new length of lines and size of surfaces not relative but actual.

Play that the large square is a drill ground for soldiers.

If the ground is 1 block long, how wide is it? (Ans. 1 block wide.)

If one company of soldiers can stand next to one another on this side (pointing to one edge), how many can stand next to one another on this edge (pointing to another edge)? When folded into oblongs these questions:

If there is room for one company to drill here (showing 1 oblong), there is room for how many companies to drill here (show other oblong)? After triangle is folded back repeat question and get relation 1 to 2.

LESSON V

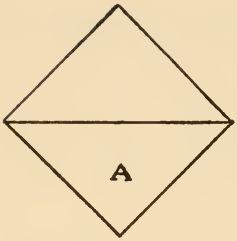
Fireman's Cap

No new number relation. A review of relations found in Lessons III and IV. Use a different size of paper.

Make soldier's cap; then press the front and back points of the cap together. Hold so that 2 free points point upward. Fold one of them back until it touches bottom corner. Result: Fireman's cap.

Play that the oblongs are windows in the engine house. Question on time it takes to wash them.

Play that squares are floors. Question on scrubbing. Or play that squares are sheets on fireman's bed. Question on hemming of edges; or, in comparing two surfaces, question on length of time to iron them.



Play that triangle is a piece of rubber for making the hat. Problems on cost of it. If this piece of rubber (pointing to *A*) costs a nickel, what does this cost (pointing to opposite square)? Ans. 2 nickels. If it costs 8 cents? Ans. 2, 8 cents.

LESSON VI

Envelope

(New relation 1 to 4 and 1 to 3.)

Play the square is the top of a desk.

Compare cost of varnishing to another child's square just the same size.

When folded on a diagonal, play that one triangle thus formed is a tile of the school vestibule floor. Compare cost of this with opposite triangle.

Teacher holds her paper so that folded edge is down. She folds one of the upper points (A) to center of folded edge. Children imitate. Result: Fig. 1.

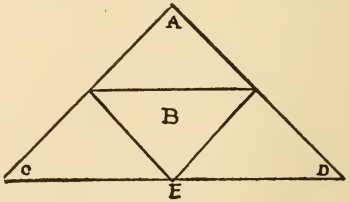


Fig. 1

B is a whole surface itself. Compare it with opposite surface. Relation 1 to 4.

If B is one tile opposite surface is 4 tiles.

If B costs a dime opposite surface costs 4 dimes, etc.

Fold point C to E. Result: Fig. 2.

F is a whole surface, so is G; compare F to G. Relation 1 to 2.

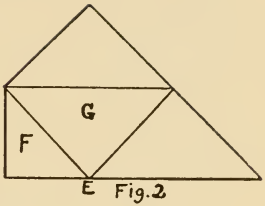


Fig. 2

Fold point D (Fig. 1) to E. Result: Fig. 3.

Compare F and H. Relation equal.

Compare F and G. Relation 1 to 2.

Compare H and G. Relation 1 to 2.

Compare G with opposite surface. Relation 1 to 3.

Of course, give concrete problems to get these relations.

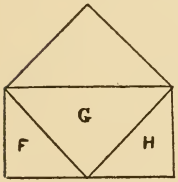
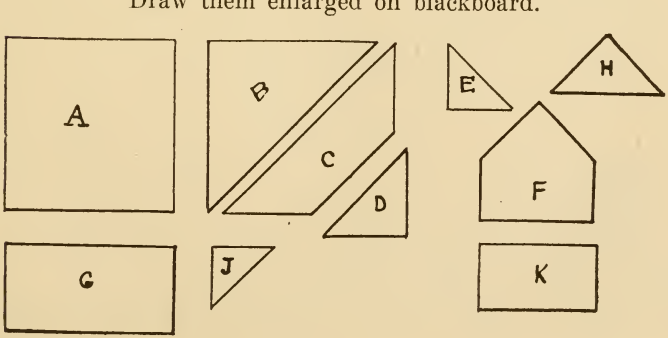


Fig. 3

Surfaces Seen While Making Envelope

Draw them enlarged on blackboard.



Base problems on some of these comparisons:

A=2 of B.
=2 of G.
=8 of D.
=8 of H.

C=3 of D.
=6 of E.
=6 of J.
=3 of H.
=sum of H, D, E, J.
=sum of K, E, J.

B=sum of C+D.

G=B.
=4 of H.
=8 of J.

G =8 of E.
=4 of D.
=$\frac{1}{2}$ of A.

K=2 H's.
=F-D.

E=$\frac{1}{2}$ of D.
=$\frac{1}{6}$ of C.
=$\frac{1}{6}$ of F.
=$\frac{1}{4}$ of K.

D=$\frac{1}{3}$ of F.
=H.
=2 of J.
=$\frac{1}{3}$ of C.
=$\frac{1}{4}$ of B.

LESSON VII

Picture Frame

Relation 1 to 4; 1 to 5; 1 to 6.

Fold square into 2 equal oblongs.

Fold so that short edges of oblongs touch. Open. Large square is now divided into 4 small squares. (Fig. 1.)

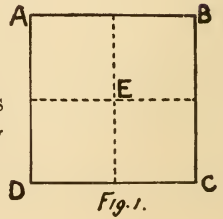


Fig. 1.

Fold so that point *A* touches center (*E*).

Fold so that point *B* also touches center (*E*.) (Result, Fig. 2.)

Compare surface *F* with surface *G*, Fig. 2. Relation equal.

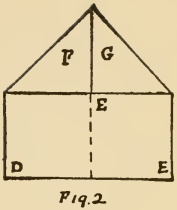


Fig. 2.

Compare surface *F* with opposite surface. Relation 1 to 6.

Compare surface *G* with opposite surface. Relation 1 to 6.

Fold so that point *D* touches center *E*, Fig. 3.

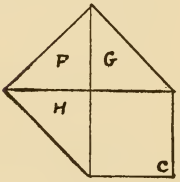


Fig 3

Compare *H* to *F* or *G*. Relation equal.

Compare *H* to opposite surface. Relation 1 to 5.

Fold point *C* to center *E*, Result, Fig. 4

Compare surface *J* to opposite surface. Relation 1 to 4.

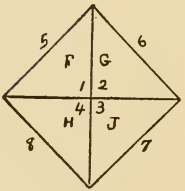


Fig 4

Fold back point 1 to middle of edge 5.

Fold back point 2 to middle of edge 6.

Compare *K* and *M* (Fig. 5).

Compare *K* and *H*, etc.

Fold back point 4 to 8 and 3 to 7.

Result: Picture frame for a doll's house.

Base the concrete problems on things pertaining to a doll's house.

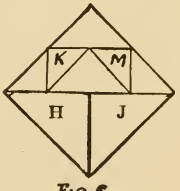


Fig 5

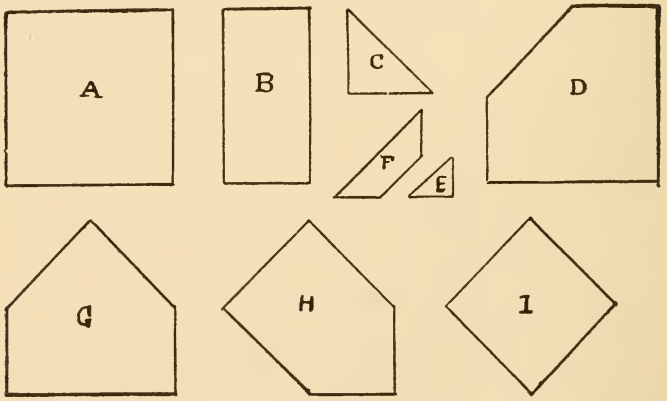
The squares and oblongs can be lace curtains for the doll house. Question about length or cost of lace for the curtains. Some curtains having lace on 2 edges, others on 3 edges.

Let triangle F (Fig. 4) be a doll's shawl. Let opposite surface be a piece of cloth. Ask how many shawls can be cut from it.

Let small square (Fig. 1 before it is opened) be a handkerchief. Question on cost of lace on edges, or time to hem them.

Surfaces Seen While Making Picture Frame

Draw them enlarged on blackboard. Suggestive comparisons:



A=2 of B.
=8 of C.
=2 of I.

A=sum of D+C.
=sum of H+3 C's.
=sum of I+4 C's.

A=sum of G+2 C's.
=sum of D+E+F.
=sum of G+C+E+F.
C=$\frac{1}{4}$ of B.
=$\frac{1}{4}$ of I.
=sum of E+F.
B=sum of C+E+F.
=$\frac{1}{2}$ of A.
=I.

D=B+3 C's.
=7 C's.
G=6 C's.
=I+2 C's.
H=I+C.
=5 C's.
I=4 C's.
F=3 E's.
=C–E.

LESSON VIII

Salt and Pepper Holder

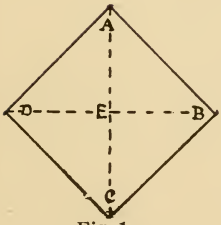


Fig. 1.

Fold square on its diagonals.

Fold points *a, b, c, d,* to center *E* as in previous lesson, getting small triangles to compare with opposite surface. Relations 7, 6, 5, 4, respectively. Turn Fig. 1 upside down.

Fold the four points of the new square to center *E* again and turn upside down.

Insert fingers under points 1, 2, 3, 4, Fig. 2, and squeeze into the shape of salt and pepper holder. Fig. 3.

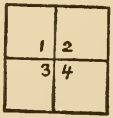


Fig. 2.

Fig. 3.

After the holder is made, inquire: If one little pocket holds 1c worth of salt, how many cents' worth will all hold?

If it holds 2c worth, how many 2c worth will all hold? (Ans. 4, 2c worth.)

LESSON IX

Boat

See Lesson IV, Soldier's Cap, for beginning of boat. Take the two side points of the soldier hat and make them touch one another. Now there are 2 free points of a square. Fold one of them back to opposite corner. Fold the other one back the other way. Result: A little soldier's hat.

Press the two free points of this together.

Fold back both in opposite directions to meet opposite corner. Result: A very small soldier's cap, with 3 points at the top. Put fingers on sides of middle point and pull the paper. Result: Boat.

When boat is made ask questions about the prow and stern of it. Bind them with iron (imaginatively, of course).

If prow is 5 yds. long, stern is 5 yds. long.

If it took 2 days to bind prow with iron, it took 2 days to bind stern with iron.

If iron on prow costs $10.00, iron on stern costs $10.00.

If it takes a week to paint 1 side of ship, it takes a week to paint other side of it.

If it takes $100.00 worth of wood to build one side it takes $100.00 worth to build other side.

Compare cost of painting 1 side of cabin to 1 side of ship on the outside. (Relation of 1 side of cabin to side of ship is $\frac{1}{3}$).

Compare cost of painting 1 side of cabin outside and inside to 1 side of ship outside and inside, etc.

LESSON X

Square Prism

(To be used for that game in which the teacher says: "I am thinking of something which looks like a square prism. Guess what it is.")

Fold a square into two equal oblongs. Open. (Fig. 1.) Make edge *A* touch folded line. Compare oblong thus obtained to opposite surface. Relation 1 to 3. Make edge *B* touch folded line. Compare oblong thus formed to opposite surface. Relation 1 to 2. Open whole paper and fold the other way into 2 equal oblongs.

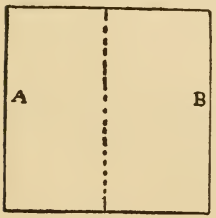


Fig 1

Fold long free edges back to long folded edge. Result: Large square is divided into 16 small squares.

Cut line 1 and fold back whole upper row of squares. (Fig. 2). Compare surface *A* with surface *b c d*. Relation 1 to 3.

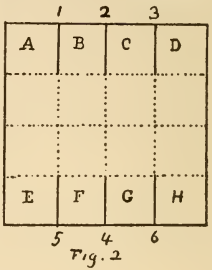


Fig. 2

Cut line 2.

Compare surface *a* with surface *cd*.

Compare surface *cd* with opposite surface. Relation 1 to 6. Cut line 3.

Cut line 4, fold back whole lower row. Compare surface *ef* with surface *gh*.

Compare surface *ef* with opposite surface. Relation 1 to 4.

Compare surface *gh* with opposite surface. Relation 1 to 4.

Cut line 5. Compare surface *e* with opposite surface. Relation 1 to 8.

Cut line 6.

Fold and paste into square prism shape.

Play game mentioned.

Concrete problems: In Fig. 1, after *a* is folded to middle fold ask:

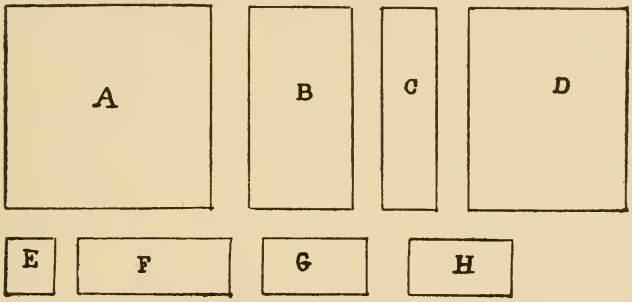
"If this wall (small oblong) needs two rolls of paper to paper it, how many rolls will this wall (opposite surface) need?" (Ans. 3, 2 rolls.)

After *B* is folded to middle fold ask: "If one man paints this wall in 4 hrs., how long will it take him to paint this one (opposite surface)?" (Ans. 2, 4 hrs.)

Children should keep square prism in school for future comparison with the cube which is to be made next out of the same sized paper, as square prism was made.

Surfaces Seen While Making Square Prism

Enlarge and draw them on the blackboard.
Base concrete problems on some of these comparisons:

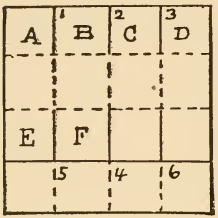


A=2 of B.
=4 of C.
= 8 of G.
=sum of D+C.
=sum of B+2 Cs.
B=2 of C.
=D–C.
=A–2 Cs.
=A–B.
B=sum of C+E+F.
=sum of C+G+H.
=sum of E+F+G+H.
=4 of G.
=$\frac{1}{2}$ of A.
C=$\frac{1}{3}$ of D.
=F+E.
=G+H.
=A–D.
=D–B.
=2 times G.
=4 times E.
F=3 times E.
=sum of G+E.
C=$\frac{1}{4}$ of A.
=$\frac{1}{2}$ of B.
F=C–E.
=$\frac{1}{4}$ of D.
G=2 Es.
=H.
=F–E.
=C–H.

LESSON XI

Cube

Fold 16 squares as in previous lesson. Cut off lower row. Compare this to surface which is left. If large surface will hold a loaf of cake, what will smaller surface hold? (Ans. $\frac{1}{3}$ of a loaf.)



If it takes 3 cups of flour for the former what will it take for the latter? (Ans. $\frac{1}{3}$ of 3 cups).

Fold back row of 3 squares. Compare this to opposite surface in same way getting result $\frac{1}{3}$. Then put questions the opposite way, getting result 3.

Fold back other outside row of 3 squares and repeat questions, getting answers $\frac{1}{2}$ and 2.

Open folds, making large flat surface with 12 small squares. Make cut 1. Fold back surface *bcd*.

Compare it with opposite surface. Relation $\frac{1}{3}$ and 3.

Make cut 2. Compare *cd* with opposite surface.

Through questions get relation $\frac{1}{4}$ and 4.

Make cut 3.

Make cut 4. Fold back *ef*. Compare with opposite surface. Relation $\frac{1}{3}$ and 3.

Make cut 5.

Make cut 6.

Fold and paste into a cube.

Compare Cube and Square Prism

How many cubes like this can be cut from the square prism?

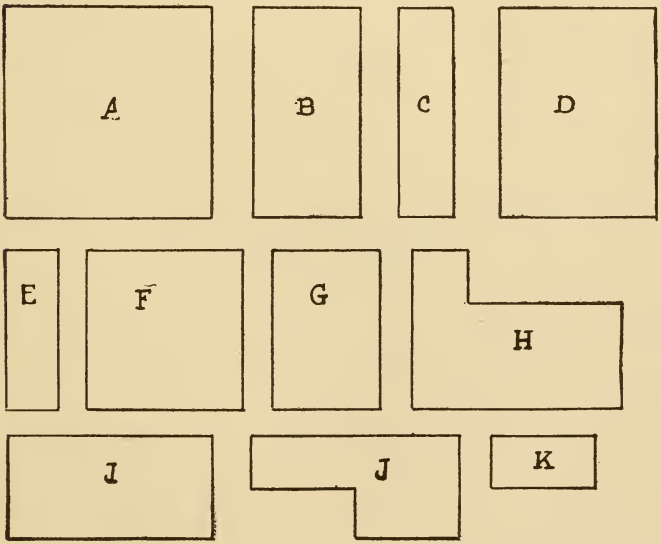
How many times larger is the square prism than the cube?

The cube is what part of the square prism? If the cube is a child's building block, how many can be made from the square prism? If the little block costs a nickel, what does the big one cost? (Ans. 2 nickels). If the prism costs 6c what does the cube cost? (Ans. $\frac{1}{2}$ of 6c), etc.

Surfaces Seen While Making Cube

Enlarge and draw them on the blackboard.

Base concrete problems on some of these comparisons:



C=$\frac{1}{4}$ of A.
=$\frac{1}{2}$ of B.

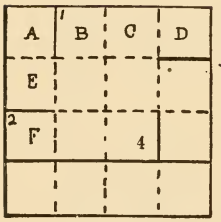
C=$\frac{1}{3}$ of D.
=$\frac{1}{2}$ of I.

C=2 of K.
E=$\frac{1}{3}$ of F.
=$\frac{1}{2}$ of G.
=$\frac{1}{3}$ of H.
=$\frac{1}{2}$ of J.
=$\frac{1}{4}$ of D.
=F–G.
=D–F.
H=sum of G+E.
=sum of J+E.
D=sum of H+E.
I=B.
=2 of C.
=$\frac{1}{2}$ of A.
=4 of K.
=sum of J+K.
J=3 of K.
=G.
=2 of E.
=C+K.

LESSON XII

Cradle

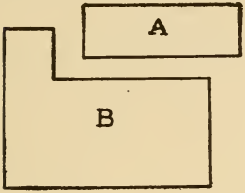
Cut off lower row of squares. Compare this with large surface. If small surface is enough cloth for a pillow case for baby's bed, what is large surface? (Ans. Enough for 3 pillow cases). Make cut 1. Fold back *b-c-d*. Compare it with large surface. Relation 1 to 3. Folding back *a-e-f* and comparing it to what is left on opposite side gives the relation 1 to 2. Make cuts 2, 3 and 4. Fold and paste into box shape. Rockers to be made free-hand from row of squares cut off originally, then pasted on.

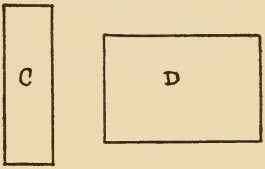


New Surfaces Seen While Making Cradle

(For other surfaces see lesson on Cube).

Enlarge and draw them on the blackboard. Base concrete problems on the comparisons:



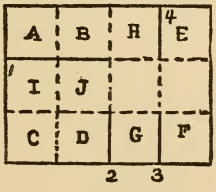


A=½ of D.	B = 3 of A.	D=2 of A.
=⅓ of B.	=3 of C.	=2 of C.
=C.	C=½ of D.	=sum of A + C.
B=sum of D+C.	=⅓ of B.	=B–C.
=sum of D+A.	=B–D.	=B–A.

LESSON VIII

Chair

Fold 16 squares. Cut off one row. Make cut 1. Fold back *ab*. Compare this with opposite surface. Play it is a blackboard. Pointing to opposite surface, this blackboard is how many times as large? (5 times.) If it takes one boy 1 minute to clean it, how long will it take him to clean the other? (5 minutes.) How many boys could clean it in 1 minute? (5 boys.) Make cut 2. Fold back *c-d* and repeat comparisons—getting result 4 in-



stead of 5. Make cuts 3 and 4. Fold back *e* and *f*. Compare *c-d* to what is left on opposite side. Result: Relation 3. By reversing questions get relations 1/5, 1/4, 1/3, respectively.

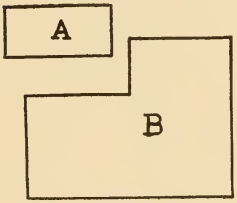
Paste *e* under *h*.

Paste *f* under *g*.

Paste *a* under *g* and *f*.

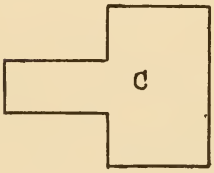
Paste *c-d* on *i-j* to strengthen back. Then chair is made. Legs may be cut out free-hand.

Chair

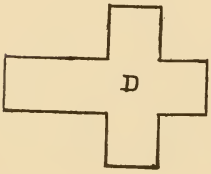


Enlarge and draw on blackboard new surfaces not seen in previous lessons.

Give concrete problems based on these comparisons:



A=1/5 of B.
=$\frac{1}{4}$ of C.
=$\frac{1}{3}$ of D.
B=sum of C+A.
=sum of D+2 A's.
C=4 of A.
=B–A.
=D+A.
D=3 of A.
=C–A.
=B–2 A's.

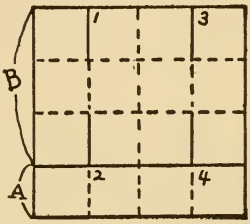


LESSON XIV

Buggy

From two equal oblong papers fold to get squares. From the little extra oblongs cut wheels and shafts free-hand.

Fold one square into 16 small squares. Cut off 1 row.



Compare this to 12 squares which are left.

Base problems on things seen when driving.

If *a* requires 10c worth of grass seed, *b* requires 3, 10c worth.

If it takes 2 days to put a cement walk on *a*, it takes 3, 2 days to put one on *b*.

If *a* yields 5 bu. corn *b* yields three 5 bu.

If *b* yields 3 pk. potatoes *a* yields $\frac{1}{3}$ of 3 pk., etc.

Make cuts 1 and 2. Fold back left row and compare to opposite surface. Relation 1 to 3.

Make cuts 3 and 4. Fold back right row and compare to left row (equal). Also compare to opposite surface. (Relation 1 to 2.) Fold and paste into box shape. Do same with other square.

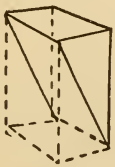
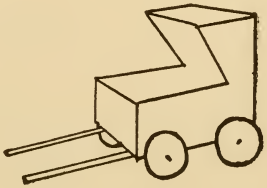


Fig. 2



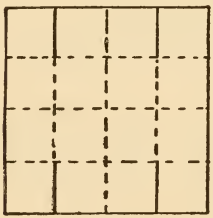
Compare volumes of two box shapes. If one holds ½ pk. oats for horse the other holds ½ pk., etc.

Cut one of these as indicated in Fig. 2.

Insert and paste this into other box shape. Use toothpicks for axles, adjust wheels and paste on the shafts.

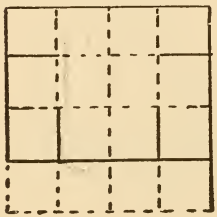
BASKETS

This is a series of basket patterns more than anything else, just to show what a variety can be made from 16 squares cutting either on a straight fold or a diagonal. I have partially shown the variety of surfaces to be compared, but have not inserted any concrete problems, though of course they should be given whenever any comparing is done.



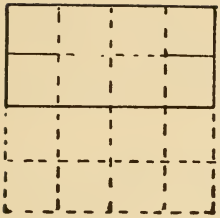
LESSON XV

Ordinary box shape, based on 16 squares, straight cuts.



LESSON XVI

Oblong box shape. 1 row of squares cut off, straight cuts. Cutting for flaps different to give differently shaped surfaces on which to base problems.



LESSON XVII

16 squares; 2 rows cut off; straight cuts.

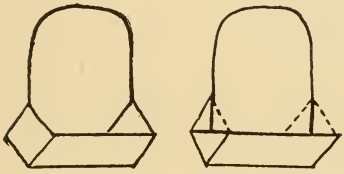
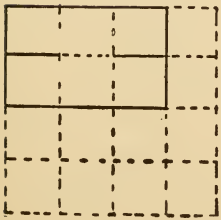
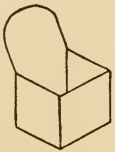


Fig. 3 is the result when the free corners are cut off.

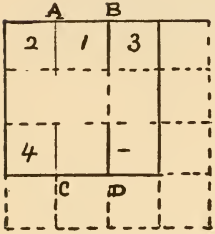
LESSON XVIII.





Like a cube with two sides cut out.

LESSON XIX



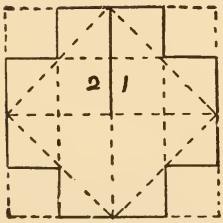
Box shape; 9 squares; straight cuts. When bottom row is cut off number relation is 1 to 3.

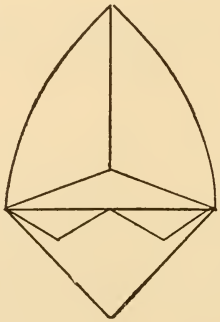
When right row is cut off number relation is 1 to 3.

Make cuts *a b*. Fold back 2, 3, and 1. The sum of 2 and 3 can be cut how many times out of opposite surface? Sum of 2 and 3 is what part of opposite surface? Make cut *C* and fold back 4. Compare to opposite surface. Relation 1 to 5. Make cut *d*.

Fold and paste into box shape.

LESSON XX

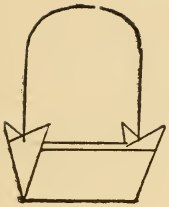


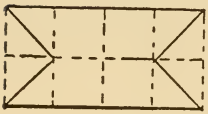


Make cuts indicated and fold on the diagonals seen. Paste 1 on 2. Make handle of 3 strips cut free - hand. Result:

Fig. 2.

LESSON XXI

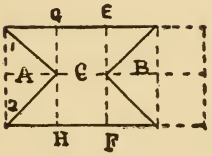




Eight squares. Diagonal cuts.

Cut off free corners if you so desire.

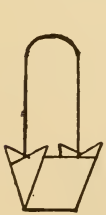
LESSON XXII



Six squares. Diagonal cuts. After *a* and *b* are cut out, the sum of *a* and *b*=½ of whole surface left.

a is ¼ of whole surface.

b is ¼ of whole surface.



Whole surface=4 of *a* or
4 of *b* or
2 times the sum of *a* and *b*.
Fold on horizontal dotted line.
Now *a* is ½ of surface seen.
Now *b* is ½ of surface seen.
Sum of *a* and *b* equals surface seen.
Cut *a* on horizontal dotted line.
Triangle 1 is ½ of *b*.
B=2 of triangle 1.

Open.
Fold back on line *e-f*.

Compare b to surface seen ($\frac{1}{3}$).

Fold on horizontal dotted line again.

Compare triangle 1 to surface seen ($\frac{1}{3}$).

Open.

Fold on lines g-h and e-f.

Compare b to surface seen ($\frac{1}{2}$).

Compare sum of $\triangle$ 1 and $\triangle$ 2 to surface seen ($\frac{1}{2}$).

Compare sum of $\triangle$ 1 and $\triangle$ 2 and b to surface seen equal.

Fold and paste.

LESSON XXIII

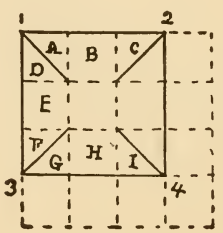
Fold back whole upper row after cuts 1, 2 are made. Compare Fig. a-b-c with opposite surface. Relation 1 to 3.

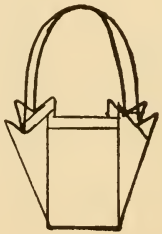
Make cut 3. Fold back whole left row.

Compare surface a-b-c to surface d-e-f. Compare d-e-f to opposite surface. Relation 1 to 2. Make cut 4. Compare g-h-i to opposite surface. They are equal.

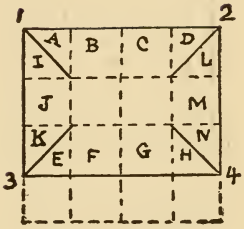
Make long edge of triangle f touch right edge of triangle g and paste. Treat other corners similarly.

Cut two long strips free-hand for handles.





LESSON XXIV



Make cuts 1 and 2.

Fold back surface *a-b-c-d.*

Compare this with opposite surface.

Relation 1 to 3.

Make cuts 3, 4.

Fold back surface *e-f-g-h.*

Compare this surface to surface *a-b-c-d* (equal).

Compare it to opposite surface (relation 1 to 2).

Fold back *i-j-k.*

Compare *i-j-k* to opposite surface (relation 1 to 2).

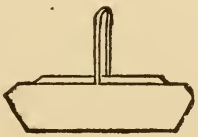
Fold back *l-m-n.*

Compare it to *i-j-k.*

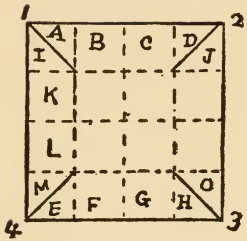
Compare it to opposite surface (equal).

Make long edge of △ *a* touch lower edge of △ *i.* Paste. Treat other corners similarly. Cut off points which protrude. Cut handle free-hand.

This makes a nice basket for Red Riding Hood, or a shopping basket.



LESSON XXV



Make cuts 1, 2.

Fold back whole upper row.

Compare *a-b-c-d* to whole opposite surface ($\frac{1}{4}$).

Cut 3, 4.

Fold back *e-f-g-h*.

Compare surface *a-b-c-d* to surface *e-f-g-h* (equal).

Compare *i* to surface *a-b-c-d*.

Compare *i* to *j*.

Compare sum of *i* and *j* to surface *a-b-c-d*. ($\frac{1}{3}$).

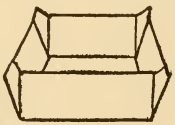
Compare *e-f-g-h* to opposite surface. (Remember that top row is turned back). Relation 1 to 3.

Fold back *i-k-l-m;* also *o*.

Compare *i-k-l-m* to *a-b-c-d;* or *e-f-g-h* (equal).

Compare *i-k-l-m* to opposite surface ($\frac{1}{2}$).

Fold and paste so that longest edge of triangle *a* touches lower edge of triangle *i*. Treat other corners in like manner. Cut off protruding points. Result: workbasket for sewing materials.



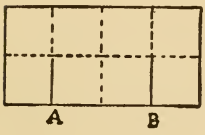
FOLDING AND WEAVING

LESSON I

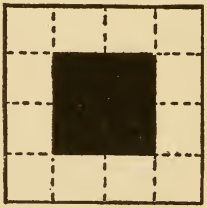
Material: Paper 6″x9″.

Fold and tear so that a 6-inch square is obtained. Color remaining oblong, which is 6″x3″, on one side with crayola.

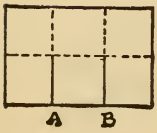
Compare the two surfaces, giving problems on size and cost of rugs; also fringe on edge. Fold 6 inch square into 16 small squares. Then fold into two equal oblongs.



Make cuts indicated at *a* and *b* on folded edge. Fig. 1. Open. Weave with the colored strip. Result: Fig. 2.

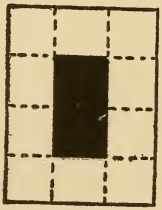


LESSON II



Repeat Lesson *I*, but tear off one row of the sixteen squares making cuts *a-b* (Fig. 1) on folded edge.

Weave with colored strip. Result: Fig. 2.



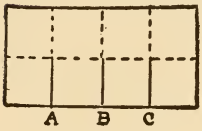
LESSON III

Paper same as Lesson *I.*

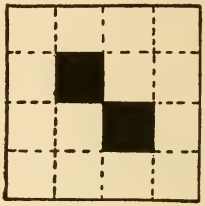
Fold and tear to get 6-inch square. Color with crayola the oblong which is left. Then divide it into two equal oblongs by folding and cutting or free cutting.

Fold 6-inch square into 16 small squares. Open.

Fold into 2 equal oblongs.



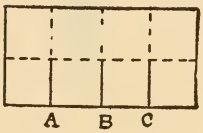
Make cuts indicated at *a, b, c* on folded edge (Fig. 1). Open and weave. Result: Fig. 2.



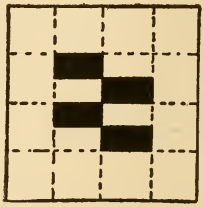
LESSON IV

Paper 6″x9″.

Make 6-inch square and color oblong which is left. Cut this oblong into 4 equal oblongs by folding and cutting on fold or free cutting. Fold square into 16 small squares. Open. Fold into 2 equal oblongs.



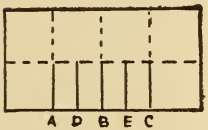
Make cuts indicated at *a, b, c* on folded edge (Fig. 1). Open and weave. Result: Fig. 2.



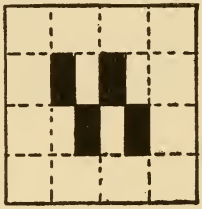
LESSON V

Paper 6″x9″.

Fold so that a 6-inch square is obtained. Color the oblong which is left. Divide it into 2 equal oblongs. Fold square into 16 small squares. Open and fold into two equal oblongs.



Make cuts indicated at *a, b, c* on folded edge (Fig. 1). Now with free-hand cutting (judging with the eye, there is no fold to cut on) make cuts *d, e.* Open and weave. Result: Fig. 2.



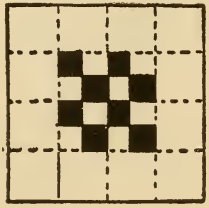
LESSON VI

Paper 6″x9″.

Fold so that a 6-inch square is obtained. Color oblong which is left. Cut it into 4 equal oblongs. Fold square into 16 small squares. Open and fold into 2 equal oblongs. Make cuts indicated at *a, b, c,* on folded edge.

Result: Fig. 1.

Make cuts *d* and *e* free-hand. Weave. Result: Fig. 2.

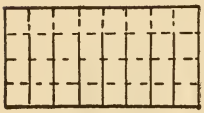


Color the border if you care to.

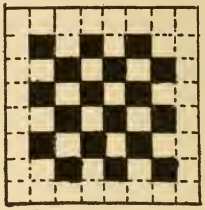
LESSON VII

Two 8-inch squares contrasting colors.

Fold the one which is to be used for strips into 8 equal oblongs. Cut on folds. Fold the other square into 8 oblongs one way. Open and fold into 8 oblongs the other way.



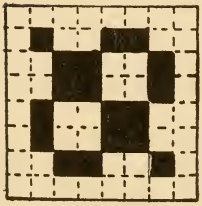
Open and fold into 2 large equal oblongs. Make cuts indicated in Fig. 1 on folded edge. Open and weave. Result: Fig. 2.



LESSON VIII

Two 8-inch squares contrasting colors.

Fold the one to be used for strips into 4 equal oblongs.



Cut. Then divide one of those oblongs into 2 equal smaller oblongs by free cutting or folding.

Fold the other 8-inch square into 4 equal oblongs.

Fold the two free edges back to the opposite folded edge. Open.

Fold the other way in same manner. Make cuts and weave with a narrow strip first, two wide ones next and a narrow one last. Result: Fig. 1.

LESSON IX

Two 8-inch squares contrasting colors.

Fold the one to be used for strips into 4 equal oblongs. Divide 2 of these lengthwise into 2 equal oblongs by free cutting or folding.

Fold the other 8-inch square into 4 equal oblongs. Fold the 2 free edges back to meet opposite folded edge. Open and fold the other way in same manner. Make cuts and weave with 2 narrow strips first, then a wide one, then two more narrow strips. Result: Fig. 1.

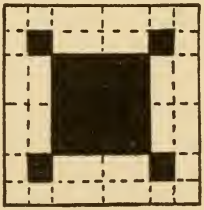
LESSON X

Two squares, contrasting colors, any size that is large enough.

Fold the one to be used for strips into 2 equal oblongs. Divide one of these into 2 smaller oblongs. Divide one of these 2 small ones into two equal smaller oblongs. Cut.

Fold the other square into 4 equal oblongs.

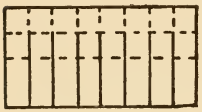
Fold the 2 free edges back to opposite folded edge. Open and fold the other way in same manner. Make cuts, open and weave, using two narrow strips first, then the wide one, then the other two narrow ones; going over one and under two. Result: Fig. 1.



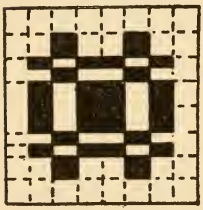
LESSON XI

Two squares, contrasting colors.

Cut the square to be used as strips into 4 equal oblongs. Bisect two of these lengthwise and then divide 2 of the narrow oblongs thus obtained into 2 equal smaller ones.



Fold the other square into 8 equal oblongs. Open and fold the other way into 4 equal oblongs. Fold back the 2 free edges to the opposite folded edge. Open so that the paper is folded into halves.



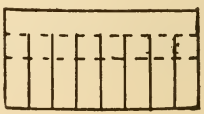
Make cuts indicated from folded edge (Fig. 1). Open and weave, going over two and under one, using one middle sized strip first; then 2 narrow ones, then 1 wide one, then 2 narrow ones, then 1 middle sized one. Result: Fig. 2.

LESSON XII

Two squares, contrasting colors.

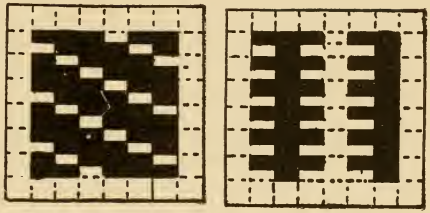
Cut the square to be used as strips into 4 equal oblongs. Divide each one of these lengthwise into 4 equal oblongs. Sixteen narrow strips are the result.

Fold the other square into 8 equal oblongs. Open and fold the other way into 4 equal oblongs. Fold back the two free edges to meet opposite folded edge. Open so that paper is folded into halves.



Make cuts indicated from folded edge (Fig. 1). Open and weave over 3 and under 1.

Fig. 2 shows two results of weaving this way.



FREE CUTTING AND WEAVING

The child has dealt with the relations 1, 2, 3, 4, equal, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$ in the folding lessons; now he is ready to do some free cutting. He should try to cut a piece of paper into 2, 3 or 4 equal pieces, as the case may be.

LESSON I

Material: Paper 6″x9″.

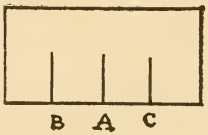
Fold and cut to get 6-inch square.

Color oblong, which is left with crayola.

Cut into 2 equal oblongs.

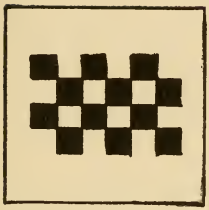
Fold square into 2 equal oblongs.

Hold it so that folded edge is down. Now cut so that folded edge is divided into 2 equal parts and cut is made half way to top of paper. (Fig. 1*a*.)



Divide left half of folded edge into 2 equal parts the same way (*b*). Divide right half same way (*c*). Open and weave. Result same as Folding Lesson III.

LESSON II



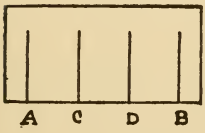
Repeat I, but cut the oblong which is for strips into 4 equal parts instead of 2.

After folded edge of mat is divided into 2 equal parts, divide each half into 4 equal parts, cutting half way to upper edge. Weave.

LESSON III

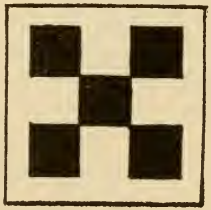
Material: Two 5-inch squares, contrasting colors.

Fold the one which is to be the mat into 2 equal oblongs. It is time now to show the children how to cut a strip for the border, along each end about ½ an inch wide and within half an inch of the top (*a*, *b*).



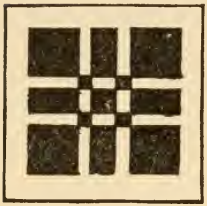
Now divide the folded edge between *a* and *b* into 3 equal parts and make cuts *c*, *d*, stopping half an inch from the top. Open.

Cut an inch strip from the other 5-inch square. Teacher cuts first. Child imitates. This 1-inch strip is discarded after some concrete problems have been given causing child to compare it to surface which is left. (Relation 1 to 4.)



Cut this large surface into 3 equal oblongs, making cuts parallel with long edges of surface. Weave.

LESSON IV



Material: Two 8-inch squares, contrasting colors.

Make foundation same as in Lesson III.

When 3 strips have been cut, divide one of them into 3 equal oblongs cutting lengthwise. Divide middle strip of mat into 3 equal parts. Weave, using wide strip first, then 3 small ones, then other wide one.

LESSON V

Material: Two 9-inch squares, contrasting colors.

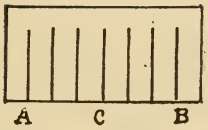
Foundation same as Lesson III.

Divide two of the three strips for weaving into 3 equal oblongs each.

Divide the left and right strips of the mat into 3 equal parts, leaving middle one as it is.

Weave, using 3 narrow strips first, then the wide one, then 3 more narrow ones.

LESSON VI



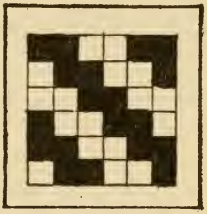
Material: Two 10-inch squares, contrasting colors.

Fold one square into 2 equal oblongs, cut the half-inch strips for border (*a, b*) from folded edge. Divide folded edge into 2 equal parts at *c*.

Divide *a-c* into 3 equal parts. Divide *c-b* into 3 equal parts.

Cut an inch strip from other square.

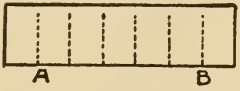
Divide large surface into 2 equal oblongs, cutting parallel to long edges.



Cut each of these into 3 equal parts. Weave in any desired way. Over one, under one; over two, under one; over two, under two; over three, under one; over three, under two.

LESSON VII

Material: Two oblongs 8″x5″, contrasting colors.



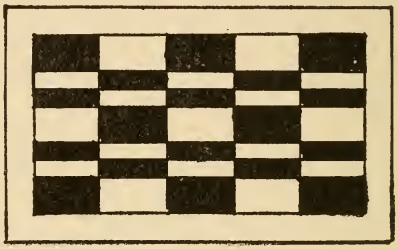
Fold the one which is for the mat so that the long edges meet. Cut as indicated at *a, b,* making strips for border. (Fig. 1.)

Divide the fold between *a* and *b* into 5 equal parts, cutting to half an inch from top.

Cut an inch strip from one of the long edges of the other oblong from which strips are to be cut.

Now divide this into 5 equal oblongs, cutting parallel to long edges.

Cut 2 of these oblongs into two smaller equal oblongs each. Weave thus: one wide strip, two narrow, one wide, two narrow, one wide. Result: Fig. 2.



WALL PAPER MADE BY FREE-CUTTING

Fig. 1. Strips any width, pasted on background at a distance from one another equal to their own width. Border, little oblong strips, same width as wall paper strips, laid as shown.

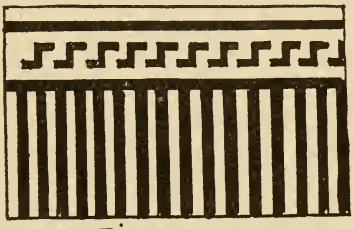


Fig. 1

Fig. 2. Strips any width, pasted on background so that distance between strips is twice the width of the strips. For border, cut strips same width as other strips, but have relation of length of small oblongs to be cut from these strips 1 to 2. Paste border as suggested.

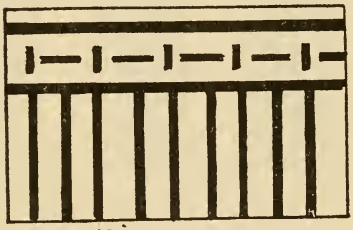


Fig. 2

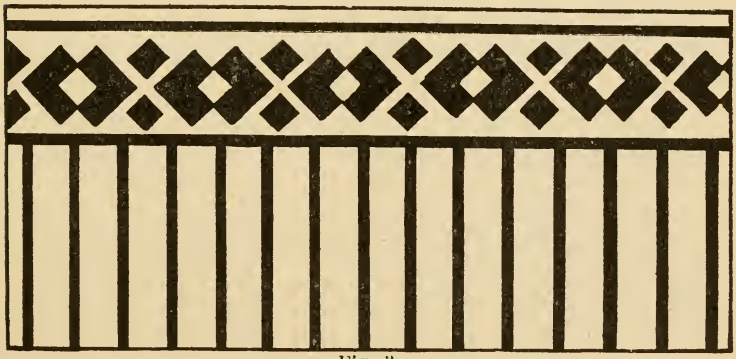


Fig. 3.

Fig. 3. Relation of strips to background space 1 to 3. Border made from equal squares, which have one corner cut out. Relation of this corner to part left is 1 to 3.

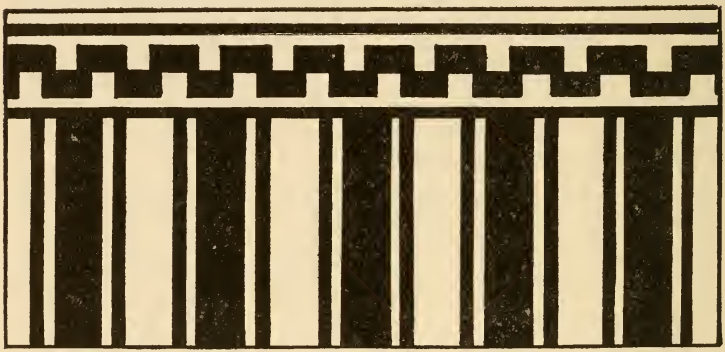


Fig. 4.

Fig. 4. Strips grouped. Relation of narrow to wide strips 1 to 4. Relation of spaces seen in background 1 to 4.

Width of oblongs in border twice that of narrow strips. Oblongs placed so that one-fourth of one touches $\frac{1}{4}$ of next one.

Fig. 5. Relation of strips to background 1 to 4. Figures on background and in border are equal squares cut on a diagonal. Strips for border are half the width of the other strips.

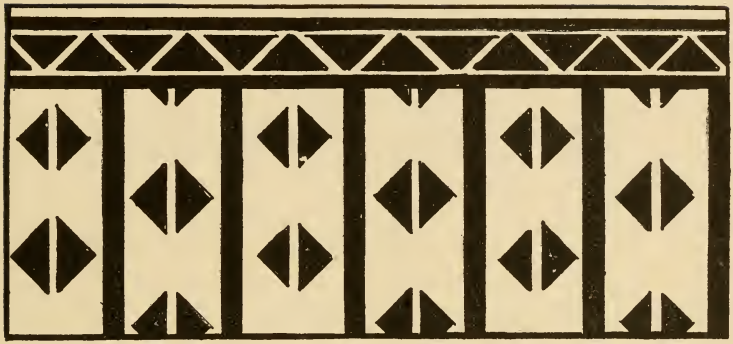


Fig. 5.

PAPER RINGS MADE BY FREE CUTTING

Make curtains or Christmas tree ornaments of paper rings cut in a definite way. Take an 8-inch square for instance. Cut it into 2 equal parts free-hand. Divide each one of these into 4 equal parts. Now you have 8 1-inch strips 8 inches long to be divided in one of several ways according to the size of rings desired.

One way—Bisect them vertically and horizontally.

Another way—Trisect them vertically and horizontally.

Another way—Quadrisect them vertically and horizontally.

Another way—Trisect them vertically and quadrisect horizontally.

Another way—Bisect them vertically and trisect horizontally.

MEASURING AND WEAVING

LESSON I

Bank Decoration

(For bank in Ruler Lesson IX, page 93)

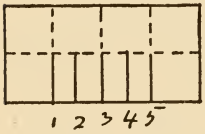
Material: A 4-inch square and an oblong 4″x2″ of contrasting color.

Rulers: 1″2″3″4″.

Compare oblong to square, giving problems. (Relation 1 to 2.)

Compare rulers and estimate length and width of papers with them.

Divide the 4-inch square into 16 one-inch squares, using rulers 3″2″1″, as shown in regular measuring lessons.



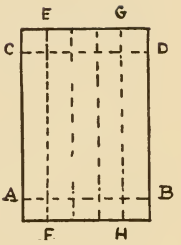
Fold it into 2 equal oblongs. Make cuts indicated on folded edges. Cuts, 1, 3, 5 are on the lines. Cuts 2, 4 are halfway between.

Cut the oblong 4″x2″ into 4 equal oblongs lengthwise. Weave.

Make six of these and paste them on the outside surfaces of the bank made in Ruler Lesson IX, page 93.

LESSON II

Calendar Back



Material: One sheet colored paper 8″x5″; one sheet paper 7″x5″, of contrasting color, from which to cut strips.

Rulers: 1″2″3″4″7″.

Tell children length and width of paper. Let them find out with their rulers what sums equal the width, 5″; or the length, 8″ or 7″. They will see.

3	2	3	3	7	3	3	3	3
2	2	1	3	1	3	2	4	1
—	1	1	2	—	1	2	—	—
5	—	—	—	8	—	—	7	4
	5	5	8		7	7		

5′ 1″=5″

4′ 2″=8″

Now on long edges of paper 8″x5″ with 7-inch ruler make marks and draw line *a-b*.

Make marks *c, d* with 1-inch ruler and draw line.

Fold lower edge to line *a-b*. Open.

Fold upper edge to line *c-d*. Open.

Use 4-inch ruler to make marks *g, h,* measuring from left on upper and lower edges. Draw line *g-h*. Now with 3-inch and 2-inch rulers respectively make the two inner long-lines.

With 1-inch ruler make marks *e, f,* and draw line.

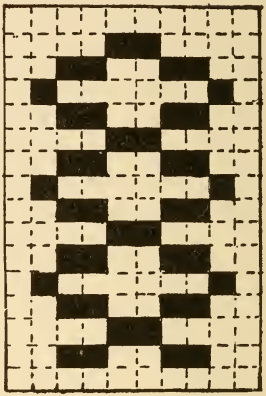
Fold lower to upper edge, having lines on the outside.

Cut from folded edge up to the fold near the top on every line which was drawn. Now divide each one of these free-hand

into two equal parts, stopping at the fold near the top. The mat is now divided into 10 half-inch strips and ready to be woven.

To make the strips divide the 7″x5″ paper into 7 one-inch strips, using single unit rulers to make points on the long edges, and draw lines connecting them.

Divide each of these by free-hand cutting into 2 equal parts lengthwise. Weave. Fig. 2.



On this paste a little art picture and a calendar. Braid 3 8-inch strands of raffia together, slip it through two holes punched at the top, tie a knot, and calendar is ready to be hung.

LESSON III

Blotter

Material for mat, 2 sheets of paper 7″x3″, contrasting colors.

Rulers: 6″5″4″3″2″1″.

Fig. 1

Make the vertical dotted lines in Fig. 1 with these rulers, using the 6-inch ruler first to make the line nearest the right; then the 5-inch ruler to make the next line to the left of that one, etc.

Using the long 6-inch ruler first and then laying the 5-inch ruler in exactly the same way, let the child see the exact difference between the two. If the short ruler were used first and then the longer one there would be an impression that the shorter one was covered up, and relationship between the two could not be seen. In building, we do not pile large blocks on top of small ones or the structure would be unstable and fall.

Take these little rulers from 1-inch to 6-inches; pile them one on the other in regular order from 1 to 6, with the 1-inch underneath. What do you see? Well, nothing worth while. Now pile them the other way: 6-inches at the bottom and 1-inch on top. See the regular steps from 1 to 6. There is just as much difference between 6 and 5 as there is between 5 and 4; 4 and 3; 3 and 2; 2 and 1. The child feels these relationships if the rulers are handled in this way—always making the large measurement first and the small one on top of it.

Fold so that the lower touches the upper edge and lines can be seen.

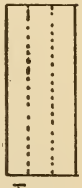


Fig-2

Now begin to cut on each line on the folded edge. Now divide each of these parts into 4 equal parts and finish all cuts, cutting until the distance from the top is exactly the width of the little parts.

Now, on the other paper draw the two vertical lines in Fig. 2, using the 2-inch and 1-inch ruler to make marks and 6-inch ruler to draw lines. Cut on lines.

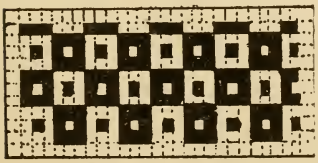


Fig-3

Subdivide each of these strips, cutting free-hand, into 4 equal long strips.

Weave.

Formula for weaving Fig. 3.

Over 3, under 3
Over 3, under 3
Over 1, under 1
} Repeat $3\frac{1}{3}$ times.

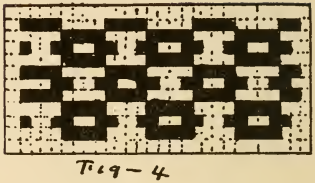


Fig – 4

Formula for weaving Fig. 4.

Over 4, under 4
Over 4, under 4
Over 2, under 2
} Repeat $3\frac{1}{3}$ times.

On top of this mat place a piece of transparent celluloid, underneath two or three sheets of blotting paper. Punch a hole in each corner and insert brass-headed fasteners. This makes a pretty blotter.

LESSON IV

Napkin Ring

Two pieces of paper, contrasting color, 7″x2″.

Rulers: 1″2″3″4″5″6″.

Divide one piece of paper into 2 equal oblongs lengthwise, using the 1-inch ruler to make marks and the 6-inch ruler to draw line. Fold so that short edges touch. Cut a little distance from folded edge on line. Now divide each half of this folded edge into 3 equal parts by making cuts. Continue all these cuts until the distance from the top equals the width of one of the strips. Open. On other paper draw lines indicated in Fig. 1, using 6″5″4″3″2″1″ rulers respectively to do it. Cut on these lines.

Fig. 1

Divide each one of these strips into 3 smaller equal ones, cutting lengthwise free-hand.

Weave in any desired way.

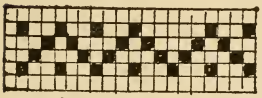
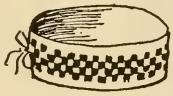


Fig. 2

Fig. 3

Figs. 2 and 3 show two different patterns.

Now put transparent celluloid on top and opaque celluloid or stiff pretty paper beneath. Punch 2 holes at each end. Sew through these holes to keep the pieces together. Now roll into ring form and slip a pretty ribbon or cord through the holes and tie in a bow or knot.



LESSON V

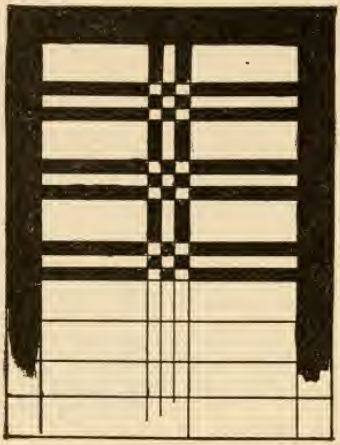
Telephone Pad

Material: One sheet colored paper 9″x12″, one sheet white paper 9″x10″.

Rulers: 1″4″5″8″.

On paper 9″x12″ draw lines indicated, using rulers 8″5″4″1″ respectively. Fold so that lower edge touches upper one and lines can be seen. Cut on lines from folded edge up to the one which indicates an inch from top.

Divide middle one inch strip into 3 equal parts, cutting free-hand up to cross line 1 inch from top. Open and press flat.



On 9″x10″ paper use the 1-inch ruler on left and right long edges to mark them off into inches. Draw lines with a long ruler. Cut on the lines. Now we have 10 strips 9″x1″. Divide 5 of them into 3 equal parts lengthwise and weave as pattern shows.

If this mat is not stiff enough paste cardboard underneath. Punch 2 holes in top, and hang with a piece of braided raffia or cord.

LESSON VI

A Wall-pocket for Letters

Two pieces stiff paper, contrasting colors, 5″x10″.

Rulers: 1″2″3″7″10″.

Combinations not seen by the children before in this book are shown in this lesson:

3	3	3
7	2	2
—	2	3
10	—	2
	7	—
		10

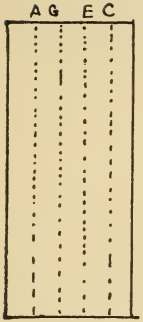


Fig 1

Measuring with 1-inch ruler from upper and lower left and right corners and drawing line with 10-inch ruler, draw *a-b, c-d.* (Fig. 1.)

Measure *e-f* with 3-inch ruler.

Measure *g-h* with 2-inch ruler.

Fold so that lower touches upper edge and lines can be seen. Cut on each line from folded edge, until half an inch from top is reached. Divide each of these parts except the middle one into two equal parts.

Collect these rulers and use a different set for the other paper. Give children 2″4″6″ 8″10″ rulers.

They see:

2	2″= 4″	6	2	2	2
3	2″= 6″	4	8	4	2
4	2″= 8″	—	—	—	—
5	2″=10″	10	10	6	4
2	4″= 8″				

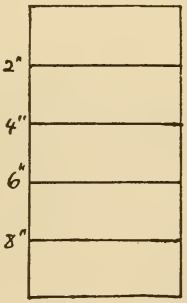


Fig 2

Draw lines indicated in Fig. 2, using rulers 2″, 4″, 6″, 8″. Cut on these lines. Divide each one of the oblongs into 4 equal pieces, cutting lengthwise, free-hand. Weave.

With 7-inch ruler measure down on long edges and fold on line. See Fig. 3.

Place and paste ends of strips under border after mat has been folded on this 7-inch line. Punch holes and lace as indicated.

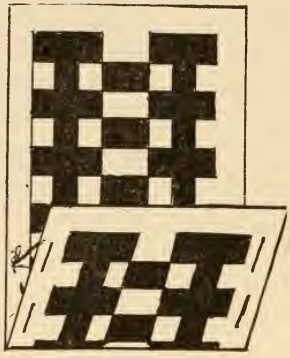


Fig. 3

LESSON VII

Circular Woven Basket

Material: An oblong 11″x2″; an oblong 11″x4″, contrasting colors; a 3½-inch square for base.

Rulers: 1″2″5″6″9″10″.

New combinations of numbers are seen when paper 11″x2″ is given to children and they are told to estimate the length of it. Not having the 11-inch ruler in their hands there is no harm in saying: "This paper is 11 inches long. Find out what rulers put together equal 11 inches, the length of the paper." They will see:

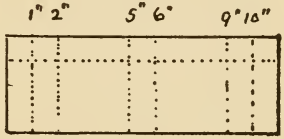
10	5	9
1	6	2
—	—	—
11	11	11

In addition to these combinations in ruler comparisons, they get:

5	9	5
1	1	5
6	10	10

Bisect this oblong (11″x2″) lengthwise, using 1-inch ruler to make marks and 10-inch ruler to draw line. Fold so that short edges touch and line is visible. Cut on line from folded edge for a short distance. Now divide each part into 3 equal parts. Cut all lines up until a distance from the top is reached equal to the width of one of them.

On paper 11″x4″ make marks and draw lines with rulers indicated in Fig. 1. Fold so that upper edge touches dotted line. Cut on fold. Save this piece for handle. Now cut on all the vertical lines. Divide every strip into 3 equal parts, cutting lengthwise, free-handed. Weave, letting twice as much of the strips protrude on one side as on the other. After the mat is woven and pasted into circular shape, these smaller protrusions should be turned in. They are the flaps, which are pasted on to the 3½″ square. Trim off protruding parts of square. The longer protrusions are turned outward and cut into any desired decorative form.

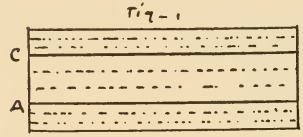


LESSON VIII

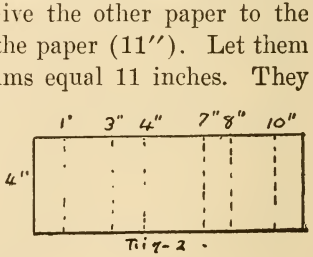
Needle-book

Material: Two sheets stiff paper 11″x4″, contrasting colors; 1 sheet thin lining paper 11″x4″; one or 2 oblongs of cloth 10″x3″; 10 inches of ribbon for fastening at hinge.

Rulers: 1″3″4″7″8″10″.



On background paper draw lines *a-b, c-d* (Fig. 1), measuring with 1-inch ruler from upper and lower edges, or with 3-inch and 1-inch ruler respectively from upper edge. Fold so that short edges meet and lines can be seen. Cut from folded edge on the lines until the distance from the opposite end is ½ the width of the narrow strips. Divide each of these strips into 3 equal parts, cutting parallel to other cuts. Give the other paper to the children. Tell children length of the paper (11″). Let them find out with their rulers what sums equal 11 inches. They will see:



7	8
4	3
—	—
11	11

In comparing rulers they will see:

3	3	7	3
4	7	1	1
—	—	—	—
7	10	8	4

Draw lines indicated in Fig. 2, measuring with rulers 10″8″7″4″3″1″, respectively, from left edge. Cut on the lines. Divide each of these pieces into 3 equal parts, except the large middle one. Divide this into 2 equal parts. Weave. Paste down all the edges of the strips, and paste lining paper on back. Fold so that short edges meet. Insert one or two pieces flannel (edges pinked). Punch 2 holes on fold and lace with ribbon.

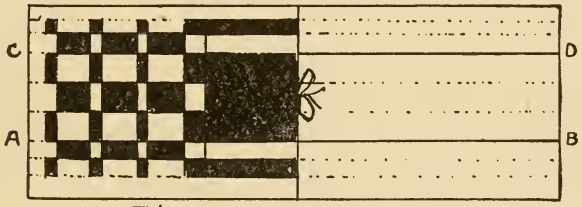


Fig 3

MEASURING

Introduction of

SINGLE UNIT RULERS

LESSON I

Scissors Holder (8-inch ruler)

Material: Use grey school paper, which is 9″x12″.

Teacher goes to wall with her paper, lays her 8-inch ruler on it as indicated in Fig. 1, then draws a line the whole *width* of the ruler at point marked *a*. Children imitate at their seats. (Children must keep their papers in the same position on the desk until all ruler work is done.)

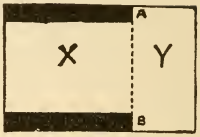


Fig. 1.

Second step: Teacher lays 8-inch ruler on lower edge of the paper and draws a 1-inch line at *b*.

Children imitate.

Teacher draws line with her ruler connecting *a* and *b*.

Children imitate.

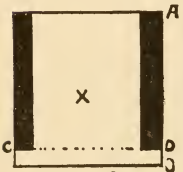


Fig. 2

Teacher cuts on line. Children imitate. Now let children compare the two oblongs *X* and *Y*.

How many sheets of cardboard as large as *y* can be cut from *x*? (Ans. Two sheets.) If this (showing *y*) costs 5c,

what does this cost (showing x)? (Ans. Two 5c.) If x costs a dime, what part of a dime does y cost? (Ans. Half a dime.) Now teacher lays 8-inch ruler along left edge of large oblong from upper left corner as indicated in Fig. 2. Draw a line the *width* of the ruler at *c*.

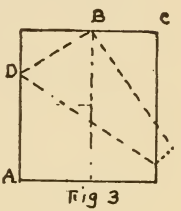


Fig 3

Children imitate.

Now lay ruler on right edge from upper right corner in same way, drawing line at *d*. Children imitate.

Draw line from *c* to *d*. Children imitate.

Cut on this line. Result: 8-inch square.

This is enough ruler work for a first lesson. Now fold into two equal oblongs. Open. Make point *a* touch middle of top line at *b*. (Fig. 3.)

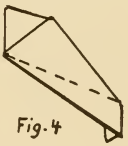


Fig. 4

Now make *c* touch *d*. Result: Fig. 4. Cut on dotted line. Scissors holder now needs only to be pasted.

LESSON II

Mayflower (8-inch and 4-inch rulers)

Make an 8-inch square as in previous lesson, but use white paper. At the end of the lesson let the children use crayola to color the hull of the boat black. The white sails will make a pretty contrast.

Call the 8-inch square the tablecloth to be used for the Thanksgiving dinner.

If 4 people can sit on one side, how many can sit at 2 sides? (Ans. Two 4 people.) How many 4 sides? (Ans. Four 4 people.)

Bisect the square, using a 4-inch ruler. Lay it on the top edge from upper left corner, drawing line at the end. Repeat on lower edge, and draw bisecting line. Fold on this line.

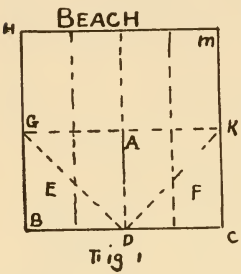


Fig 1

Now if the oblong is the table and there are 4 plates on the short end, how many on the long one? (Ans. 2, 4 or 8 plates.) (Some will say 8 plates on account of ruler measurement.)

That is enough ruler work for this early ruler lesson.

Fold one long free edge to meet fold.

If small oblong thus formed is cloth enough for a Pilgrim's dress, how many dresses can she get from opposite large oblong? (Ans. 3 dresses.)

Fold other long edge to center fold. Open. Fold the other way, making 8 small oblongs out of the 8 inch square. During process in giving problems call surfaces cloth for aprons instead. Open.

Fold so that point *b* touches center *a*.

Fold so that point *c* touches center *a*.

Compare triangles thus formed (*e* and *f*), calling them Pilgrims' shawls. If it took $1.00 worth of yarn to make *e*, how much did it take to make *f*? etc.

Some Indians had a wigwam here (pointing to *d*). Some of them ran $\frac{1}{2}$ mile along here (pointing to edge *d-g-h*) to the beach to see the Mayflower. The others ran along here

(pointing to edge *d-k-m*) to the beach. How far did the others run? (Ans. Just as far, $\frac{1}{2}$ mile.)

Fold so that point *d* touches *a*. Cut out triangles 1, 2, 3, 4. Compare size of triangles, which form sails.

If large triangle shows number of people who came over in Mayflower, and small one shows how many got sick, what part of them got sick?

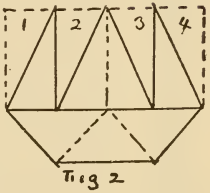


Fig 2

Many more questions can be asked if there is time; questions about clearing the ground, planting corn, chopping down trees, building log-cabins, etc.

LESSON III

Cup

Fig 1

Material: A sheet of manila paper 6″x9″.

Rulers: 6″3″.

Pass the 6-inch rulers saying, "This is a 6-inch ruler."

Pass the 3-inch rulers saying, "This is a 3-inch ruler."

Let the children put the rulers next to each other (Fig. 1).

How many 3-inch rulers can be cut from the 6-inch ruler?

Show me the part of the 6-inch ruler which equals 3″; or, show me the part of the 6-inch ruler which is just as much as the 3-inch ruler. (Children show *a*.)

Now show me the difference between the 6-inch ruler and the 3-inch ruler. (Children show *b*.)

Fig 2

Show me the sum of 6″ and 3″. Children show Fig. 2.

When in a later lesson they use rulers 3″6″9″, they will be able to say that the sum of 3″ and 6″ equals 9″. In this lesson it is enough to have them get an idea of what the word "sum" means.

Let them estimate the length of the paper which they have. They will tell you that it is the sum of 6″ and 3″ long, or 3′3″ long, or 6″ and ½ of 6″ long.

In estimating width, they will say: "The paper is 6″ wide," or "The paper is 2′3″ wide."

Now teacher lays her 6-inch ruler on upper edge and makes a mark at *a* (Fig. 3). Children imitate.

Repeat on lower edge, marking at *b*. Draw line *a*-*b*. Cut on line. Compare surfaces *c* and *d*.

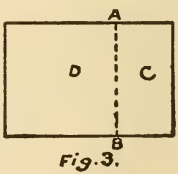


Fig. 3.

Play *c* is a towel. How many can be made from *d*? If *c* costs a nickel, *d* costs 2 nickels. If *d* costs a $1.00, *c* costs ½ of a dollar.

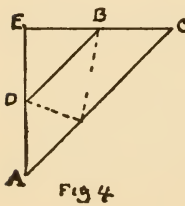


Fig 4

Now using 3-inch ruler, bisect all the edges. Do not draw the bisecting lines. They are not necessary.

Fold this 6-inch square on one diagonal with bisecting marks on the outside (Fig. 4).

Make point *a* touch mark *b*.

Make point *c* touch point *d*.

Turn back in opposite directions the two free points at *e*. Result: A drinking cup for use on a train, or in the park.

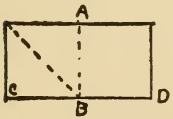
LESSON IV

Bookmark

Material: A pretty thin cardboard, a piece of cord which harmonizes in color with the cardboard.

Rulers: 2″4″.

Since cardboard comes in large sheets and must be cut up by the teacher, she may as well cut it the proper dimensions, 4″x2″, to save material. But let the children have the two rulers and compare them as in previous lesson, showing sum, difference, etc. Let them estimate length and width of paper. Let them see that sometimes the paper is just wide enough and does not need marking.

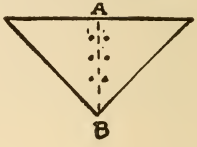


Lay 2-inch ruler on upper and lower long edges respectively. Make marks, but do not draw bisecting line. It is not necessary.

Compare triangle thus formed to opposite surface. If it is enough leather for the corner of a book, the opposite surface is enough for how many corners? If it costs a dime, how much does opposite surface cost? (3 dimes.)

Fold so that point *d* touches *a*. Compare triangle thus formed to opposite large triangle. Relation $\frac{1}{2}$. Punch holes

on the free edges of the small triangles along line *a-b*. Punch middle holes first equidistant from points *a* and *b*. Then the others equidistant from center and points *a* and *b*, respectively. Lace these and you have a book mark which fits on the corner of the page.



LESSON V

Stamp Pocket

Material: A heavy, pretty paper.

Rulers: 2″3″5″.

Make a 5-inch square, using a 5-inch ruler.

Then give the 2-inch and 3-inch rulers to children. Get sum 2+3=5.

Lay 3-inch ruler on upper edge from upper left-hand corner and make mark *a*. (Fig. 1).

Repeat on lower edge and make mark *b*.

Draw the line.

Lay 2-inch ruler on upper edge from upper left-hand corner and make mark *c*. Repeat on lower edge, making mark *d*. Draw line.

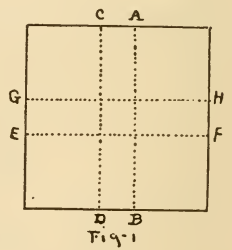


Fig. 1

Lay 3-inch ruler along left edge from upper left corner and make mark *e*. Repeat on right edge, making mark *f*. Draw the line *e-f*.

Lay 2-inch ruler along left edge from upper left corner and make mark *g*. Repeat on right edge and make mark *h*. Draw the line.

Fold so that lower edge touches upper edge. Open. (Fig. 2).

Fold so that left edge touches line *c-d*. Open.

Fold so that right edge touches line *a-b*. Open.

Cut from *e* to fold.

Cut from *f* to fold.

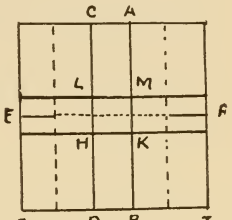


Fig. 2.

Fold so that point *g* touches *h*.

Fold so that point *i* touches *k*.

Fold so that *d-b* line touches *h-k* line.

Fold so that upper left corner touches point *l*.

Fold so that upper right corner touches point *m*.

Fold so that *c-a* line touches *l-m* line.

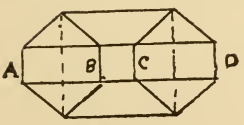


Fig. 3

Fold so that line *a* (Fig. 3) touches line *b*.

Fold so that line *d* (Fig. 3) touches line *c*.

Result: Fig. 4.

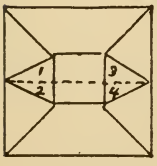


Fig. 4

Fold under the little triangles 1, 2, 3, 4 and paste. Result: A stamp holder with two pockets. Close it by making lower edge touch upper one.

LESSON VI

Traveler's Pocket for Wash Cloth

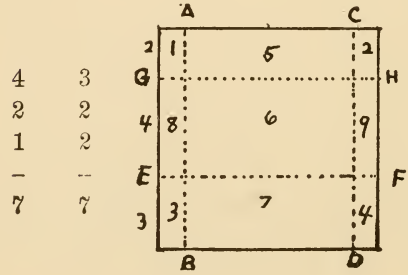
Material: Oilcloth (a 9-inch square) and a piece of tape 14″ long.

Rulers 1″ 7″ 3″ 4″.

Handling these rulers the children find that:

3	4	3	4
1	3	3	1
4	7	1	1
		7	1
			7

The children have handled a 2-inch ruler in Lessons IV and V. They see a 2-inch length in the making of this wash-cloth pocket. So, even though they haven't the 2-inch length in their hands some will see:



With the 1-inch ruler mark off 1 inch on upper edge from upper left corner. Repeat on lower edge and draw line *a-b*.

Lay 7-inch ruler on upper edge from point *a* and make mark *c*. Repeat on lower edge and make mark *d*. Draw line.

Lay 3-inch ruler along left edge from lower left corner and make mark *e*. Repeat on right edge and make mark *f*. Draw line *e-f*. Lay 4-inch ruler on left edge, beginning at point *e;* mark point *g*. Repeat on right edge and mark point *h*. Draw line *g-h*.

Cut out oblongs 1, 2, 3, 4.

Compare oblongs 5 and 6 ($\frac{1}{2}$).

Compare oblongs 6 and 8 (7).

Compare oblongs 1 and 8 ($\frac{1}{2}$).

Compare sum of 5 and 6 to 7. (They equal 2-7s.)

Fold over the flaps 8 and 9.

Fold 7 on top of them.

Fasten with brass fasteners.

Cut off triangles 1 and 2.

Sew middle of tape to point *t*.

Fold on dotted line and tie the tape on opposite side.

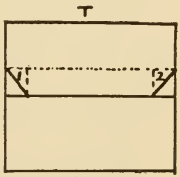


Fig. 2

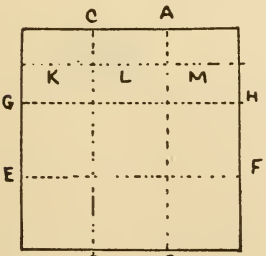


Fig. 1.

LESSON VII

Pilgrim's Bonnet

Material: White paper cambric (a 6-inch square).

Rulers: 2″4″6″.

Ruler questions:

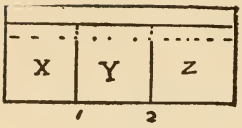


Fig. 2.

Put the 2-inch ruler next to the 4-inch ruler.

How many 2-inch rulers can be cut from the 4-inch ruler?

Show part of 4-inch ruler which equals 2-inch ruler.

Show difference between 4-inch ruler and 2-inch ruler.

Show sum of 2 inches and 4 inches.

Lay 6-inch ruler next to this sum.

How much is the sum?

Teacher writes on board:

$$\begin{array}{r} 2 \\ 4 \\ \hline 6 \end{array}$$

How many 2″ in 6″?

Show difference between 6″ and 4″.

In estimating length of 6-inch square, children will say:

It is 6″ long.

It is the sum of 4″ and 2″ long.

It is 3′2″ long.

It is the sum of 4″ and $\frac{1}{2}$ of 4″ long, etc.

Proceed with drawing of measurements. (Fig. 1.)

Lay 4-inch ruler on upper and lower edges from left-hand side. Make marks and draw line *a-b* with 6-inch ruler. Use 2-inch ruler in same way, making line *c-d*.

Laying 4-inch ruler along right and left edges from the top, make marks and draw line *e-f*.

Laying 2-inch ruler in same way draw line *g-h*. Fold top edge to line *g-h*.

Compare this surface to opposite one (relation 1 to 5).

If this cloth (pointing to small oblong) costs a nickel, what does this cost (pointing to opposite)? (Ans. 5 nickels).

If it costs a dime? (5 dimes.)

If it costs 2 cents? (5 2 cents.)

Cut off this narrow oblong.

Now fold back *k-l-m* on line *g-h*. Result: Fig. 2.

Make cuts 1, 2.

Paste or sew squares *x, y, z* on top of one another.

Cut into two equal strips the long, narrow oblong, which was cut from the 6-inch square. These are the ties. Sew or paste them on.

LESSON VIII

Stove

Rulers: 3″6″9″.

Give grey school paper which comes 9″x12″. Ask questions on rulers, bringing out following number relations:

9	9	6	3	6	2′3″=6″	3	2
−6	−3	−3	3	3	3′3″=9″	3)9	3)6
3	6	3	6	9			

Let the children estimate length and width of paper.

They will say:

The paper is 4′ 3″ long.
2′ 6″ long.
9″+3″ long.

$6''+3''+3''$ long.
$9''+\frac{1}{2}$ of $6''$ long, etc.
$3'\ 3''$ wide.
$9''$ wide.
$6''+3''$ wide.
$6''+\frac{1}{2}$ of $6''$ wide.

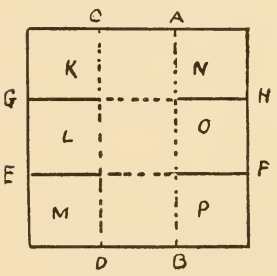
With 9-inch ruler mark off 9 inches on upper and lower edges. Draw line and cut. Compare oblong to 9-inch square. Relation 1 to 3.

If oblong shows cost of 1 lb. of meat, what does square show? (Ans. Cost of 3 lbs.)

If it shows cost of 1 pint of milk, what does square show? (Ans. Cost of 3 pints.)

If 1 pint costs 3c, what does other cost? (Ans. $3'$ 3c or 9c.)

The children ought to be able to infer 9c because they found out that $3'3''$ equals $9''$.



Using 6-inch ruler for marking and 9-inch ruler for drawing the line, make line *a-b*.

Make marks *c-d* with 3-inch ruler.

Draw line *c-d* with 9-inch ruler.

Make marks *e-f* with 6-inch ruler (laying it on left and right edges from top).

Draw line with 9-inch ruler.

Make marks *g-h* with 3-inch ruler.

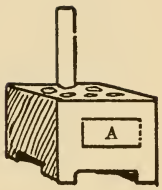
Draw line with 9-inch ruler.

Cut as indicated (Fig. 1) at *g, h, e, f.*

Paste *k* and *m* under *l*.

Paste *n* and *p* under *o*.

Cut out free-hand, cutting so that the stove will have short legs.



Make oven (a-Fig. 2), cutting 3 sides of it free-hand. Hinge is dotted line.

Cut lids from top of stove. Make stove pipe out of oblong, which was cut from the 9-inch square.

Give 2-inch rulers to children. (The oblong was 9″x3″).

Lay 2-inch ruler on right and left long edges, making marks. Draw line and cut. Result: Oblong 3″x2″. Paste 3-inch edges together, making cylinder for stove-pipe. Insert. Stove is made.

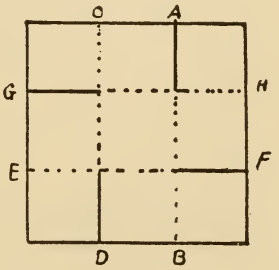
LESSON IX

Bank

Rulers: 4″8″12″.

Material: Two 12-inch squares of manila paper cut from the school paper which comes 12″x18″.

Use 6″x12″ pieces, which are left in Lesson X.



Ruler questions:

How many 4″ in 8″?

What part of 8″ equals 4″? ($\frac{1}{2}$ of 8″).

What is the difference between 8″ and 4″?

What is the sum of 8″ and 4″?

2′4″ equals how many inches?
3′4″ equals how many inches?
What part of 8″ equals 4″?
What part of 12″ equals 4″?
Estimate length and width of paper.
It is 12″ long.
It is 3′4″ long.
It is the sum of 8″ and 4″ long.
It is the sum of 8″ and ½ of 8″ long.

Lay 8-inch ruler on upper and lower edges, respectively, from left side. Mark *a, b* and draw line *a-b*. To draw line *c-d* use 4-inch ruler in same manner.

To draw line *e-f* lay 8-inch ruler on left and right edges, respectively, from top of paper. Make marks *e, f* and draw line. To draw line *g-h* use 4-inch ruler in same manner.

Fold on line *e-f*. Compare the two surfaces thus formed.

If I saved $1.00 in so much time (pointing to small surface), how much should I save in so much time (pointing to large surface)? If I save $4.00? (Ans. 2 $4.00, or $8.00—inference from ruler measurement).

If a man earns $8.00 in so much time (indicating large surface), how much would he earn in so much time? (Ans. ½ of $8.00 or $4.00.)

If a man earns $8.00 and spends ½ of his money, how much does he spend?

Make cuts indicated at *d, f, a, g*. Fold and paste into box shape.

Next day make another just like it, slipping it over the first like the cover of a box. Make a coin slit in the top. Bank is made. For decoration, see *Measuring and Weaving, Lesson I,* page 68.

LESSON X

Envelope

(In which to keep little freely cut units for decoration).

Rulers: 5″1″7″2″.

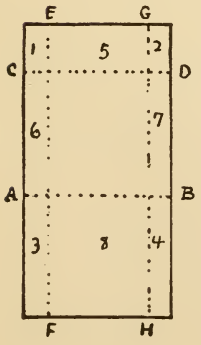
Material: Paper left from previous lesson 6″x12″.

In estimating length of paper, children will get sum of 7″ and 5″ equals 12″ even though the 12″ ruler is not in their hands, for they have handled the 12-inch ruler twice while making the bank.

In estimating width, they will get sum of 5″ and 1″ equals 6″ for same reason. They have used 6-inch ruler in Lessons III, VII, and VIII.

Other numerical values seen:

5	7	7	5	6′2″=12″
2	−2	−5	5	
7	5	2	2	
			12	



Lay 7-inch ruler on left and right edges, respectively, from upper edge; make marks and draw line *a-b*.

Use 2-inch ruler in the same way. Draw line *c-d*.

With 1-inch ruler make marks, *e-f-g-h*.

Fold line *e-f*.

Fold line *g-h*. (The children have no ruler at their desks long enough to draw this line.)

Cut out oblongs 1, 2, 3, 4.

Fold back oblongs 6, 7, and 5.

Compare 5 to opposite surface. Relation 1 to 5. Play oblong 5 is blotter.

How many blotters just as large can be cut from opposite surface?

If large blotting paper costs a nickel, what does small one cost? (1/5 of a nickel or 1c.), etc.

Put paste on flaps 6 and 7.

Paste 8 on them.

Cutting from *c* to *e* and from *d* to *g* makes the fold over flap look better.

LESSON XI

Taboret

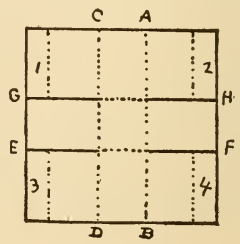
Rulers: 8″5″3″1″.

Material: An 8-inch square of rather heavy paper.

New numerical relations seen:

5	8	8
3	−3	−5
8	5	3

Lay 5-inch ruler on upper and lower edges, respectively, from left edge, making marks *a, b.* Draw line *a-b.* Lay 3-inch ruler in same way and draw line *c-d.*



Lay 5-inch ruler on left and right edges, respectively, from upper edge; make marks *e-f* and draw line.

Lay 3-inch ruler in same manner and draw line *g-h.* Make the

marks which are necessary to draw the dotted edges of the small oblongs 1, 2, 3, 4, with a 1-inch ruler. Draw the lines with the 3-inch ruler.

Cut out oblongs 1, 2, 3, 4.

Make cuts indicated at marks *e, f, g, h.*

Paste into box shape. (Fig. 2.)

Cut out sides in any desired way to form legs.

LESSON XII

Chair for Father Bear

(Story of Three Bears).

Rulers: 3″6″9″12″.

Material: School paper 9″x12″. Numerical relations seen in comparisons of rulers and estimation of length and width of paper.

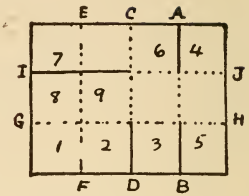
2′3″= 6″
3′3″= 9″
4′3″=12″
2′6″=12″

3″ are $\frac{1}{2}$ of 6″
3″ are $\frac{1}{3}$ of 9″
3″ are $\frac{1}{4}$ of 12″

$$3\overline{)12} = 4 \qquad 6\overline{)12} = 2$$
$$3\overline{)9} = 3 \qquad 3\overline{)6} = 2$$

3	3	6	6	3	6	9	9	12	12	12	
6	9	6	3	3	−3	−3	−6	−9	−6	−3	
9	12	12	3	3	3	6	3	3	6	9	
			12	9							

Lay 9-inch ruler on upper and lower long edges respectively, from left edge. Make marks *a, b*. Draw line *a-b*. Lay 6-inch ruler in same way and draw line *c-d*. Lay 3-inch ruler same way and draw line *e-f*.



Lay 6-inch ruler on left and right short edges, respectively, make marks *g-h* and draw line *g-h*.

Lay 3-inch ruler in same way and draw line *i-j*.

Make cut at *b*.

Fold back surface 1-2-3. Compare to opposite surface. (Relation 1 to 3.)

If it takes a roll of wall paper for this wall (indicating small surface), how many for this? (3 rolls.)

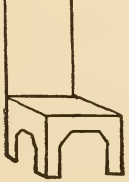
If it takes 3 rolls for small wall, how many for large wall (3′3 rolls or 9 rolls–inference from rulers).

Make cuts indicated at *d* and *a*.

Fold back square 4.

Now compare surface 1-2 to opposite surface. Relation 1 to 4.

If wall paper for small surface costs $3.00, paper for large wall costs how much? (4′$3.00 or $12.00–inference from ruler measurement.)



If it took 12 pails of plaster for large wall, how many for small wall? ($\frac{1}{4}$ of 12 pails or 3 pails), etc.

Make cut indicated at *i*.

Fold and paste so that square 5 is under 3; 4 under 6; and 7 under 3.

Fold and paste surface 1-2 under 8-9.
Cut out sides to form legs in any desired design.

LESSON XIII

Mother Bear's Chair

Rulers: 2″4″6″8″.

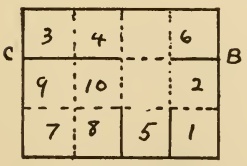
Material: Stiff paper, 6″x8″.

In comparing rulers and estimating length and width of paper, these numerical relations are seen:

		4	2 3
2′2″=4″	2″ are $\frac{1}{2}$ of 4″	2)8	4)8 2)6
3′2″=6″	2″ are $\frac{1}{3}$ of 6″	2	
4′2″=8″	2″ are $\frac{1}{4}$ of 8″	2)4	
2′4″=8″	4″ are $\frac{1}{2}$ of 8″		

2	2	2	4	8	8	8	6	6	4
2	4	6	4	−6	−4	−2	−4	−2	−2
4	6	8	8	2	4	6	2	4	2

Use rules 2″4″6″ to divide surface into 12 squares, as the 3″6″9″ rulers were used in previous lessons.



Make cuts indicated at *a* and *b*.

Fold back surface 1-2. Compare it to opposite surface. Relation 1 to 5.

Make cut indicated at *c*.

Fold back surface 3-4.

Compare this to opposite surface. Relation 1 to 4.

If this floor (showing surface 3-4) requires 2 square yards of carpet to cover it; what does this floor require? (showing large surface.) (Ans. 4′2 square yards or 8 square yards–inference from rulers).

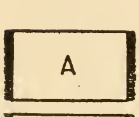
Make cut indicated at *d*.

Fold and paste so that square I is under 5; 6 is under 2; 3 is under 5.

Fold back and paste 7-8 on 9-10 to strengthen back of chair.

Make legs and back same design as Father Bear's Chair.

LESSON XIV



Baby Bear's Chair

Rulers: 1″2″3″4″.

Material: A 4-inch square of stiff paper.

Divide this into 16 1-inch squares by using rulers 1″2″3″.

Cut off one row of squares.

Play both surfaces are rugs with fringe on short edges. (Fig. 1.)

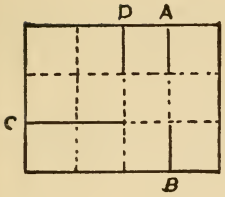
If 1 yd. of fringe is on one short edge of rug *B*, how many yds. are on one short edge of rug *A*?

How many yds. on both short ends of *a*? (2′3 yds., or 6 yds.–inference from former ruler measurement.)

How many yds. on both short ends of rug *B*? (2 yds.)

How many times as much fringe must we have for the big rug? (3 times as much.)

3′2 yds. are how many yards? (Inference from ruler measurement in previous lessons.)



Make cuts indicated at *a, b, c, d.* Fold and paste chair as in previous lessons. Make legs and back same design as father and mother bears' chairs.

Number relations seen:

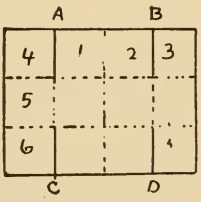
2′1″=2″	1″ is ½ of 2″	1	1	1	2	2)4
3′1″=3″	1″ is ⅓ of 3″	1	2	3	2	
		—	—	—	—	
4′1″=4″	1″ is ¼ of 4″	2	3	4	4	
2′2″=4″	2″ are ½ of 4″					
		4	4	4		
		−3	−2	−1		
		—	—	—		
		1	2	3		

LESSON XV

FATHER BEAR'S BED—RULERS :3″ 6″ 9″ 12″.

Material: 2 sheets stiff paper, 9″x12″.

Divide paper into 12 small squares, using rulers 3″6″9″, as in Lesson XII.



Make cuts indicated at *a, b.* Fold back squares 1-2. Compare this surface to opposite large surface. (Relation 1 to 5). If it is material for 1 sheet, how many sheets can be made from large surface (5 sheets). Fold back 3. Make cut indicated at *c.* Fold back 4, 5, 6. Com-

pare 4, 5, 6 to opposite surface. Relation 1 to 2. If this is material for a pillow-case, how many can be made from large surface? (Ans. 2 pillow-cases.)

If it takes 3 minutes to hem one pillow-case, how long will it take to hem 2? (Ans. 2′3 minutes, or 6 minutes.) Make cut *d*. Fold and paste into box shape.

This is enough for one lesson. Next day take the other 9″x12″ sheet of paper and make another box shape exactly the same. Compare volumes of these two. If one holds 3 lbs. of feathers, the other holds 3 lbs. of feathers.

Now cut one box shape so that it will hold half the amount of feathers. Eye measurement only.

Now if small box holds 3 lbs. of feathers, large one holds 6 lbs. If large one holds 12 lbs., small one holds $\frac{1}{2}$ of 12 lbs., or 6 lbs.

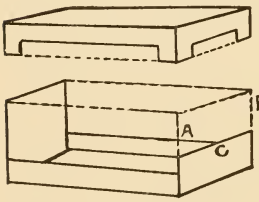
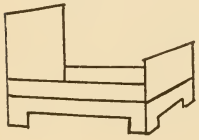


Fig. 2.

Fig. 3.

From small box shape cut so that the legs of the bed are formed.

From large box shape cut half-way down on the edges *a* and *b*. Cut across on line *c*. This is the foot of the bed. Leave opposite end as it is. This is the head of the bed. Now to get the sides, cut down half-way again on what is left of edges *a* and *b*. Then cut across to head of bed.



Paste Fig. 3 on Fig. 2 and bed is constructed. Numerical relations found in Lesson XII are reviewed.

LESSON XVI

MOTHER BEAR'S BED—RULERS: 2″4″6″8″.

Materials: 2 sheets stiff paper 6″x8″.

Make just as father's bed was made, but use rulers 2″4″6″8″ instead. Numerical relations found in Lesson XIII, reviewed.

LESSON XVII

BABY BEAR'S BED—RULERS: 1″2″3″4″.

Material: 2 sheets stiff paper 3″x4″.

Make the same as Father's and Mother's Bed, but use rulers 1″2″3″4″. Numerical relations found in Lesson XIV, reviewed.

LESSON XVIII

BOWL FOR FATHER BEAR—RULERS: 12″4″3″1″.

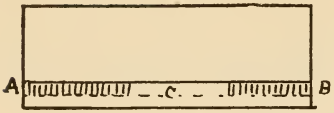
Material: Piece of paper 12″x4″ and a 4-inch square.

Numerical relations seen:

$$3\overline{)12''} \qquad 4\overline{)12''}$$

$$3'4''=12'' \qquad 4'3''=12''$$

3	4	4
1	−1	−3
4	3	1



On left and right edges, measuring from upper edge with 3-inch ruler, make marks *a, b*. Draw line *a-b*. Fold so that lower edge of paper touches line *a-b*.

Cut on the fold. Compare this long narrow oblong to large surface. Relation 1 to 7. Now fold on line *a-b*. Then on the long narrow oblong *c*, make vertical cuts about $\frac{1}{4}$ of an inch apart up to the line *a-b*.

Paste right edge on left edge to form cylinder, seeing that the little cuts on the bottom turn inward. These are the flaps. Put paste on the bottom of the flaps. Lay this cylinder on the four-inch square with flaps down. When the flaps are pasted to the square cut off the parts of the square which protrude. Bowl 3 inches high is made.

LESSON XIX

MOTHER BEAR'S BOWL—RULERS: 12″3″2″1″.

Material: Piece of paper 12″x3″; a 4-inch square.

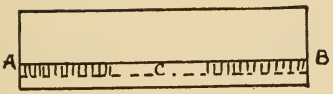
Number relations seen in this lesson:

6′ 2″=12″
4′ 3″=12″
12′ 1″=12″

$3\overline{)12}$ 4

$2\overline{)12}$ 6

2	3	3
1	−2	−1
3	1	2



Lay 2-inch ruler on left and right edges respectively. Make marks *a, b*. Draw line with 12-inch ruler. Fold so that lower edge touches line *a-b*. Cut on fold. Compare this to large surface. Relation 1 to 5. Fold on line *a-b*. Compare this long narrow oblong to opposite surface. Relation 1 to 4. If it is a board in the floor what is the other? (4 boards).

If it costs 3c, what does other cost? 4'3c or 12c.

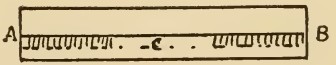
Make the little cuts for flaps up to line *a-b*.

Paste right on left edge, seeing that flaps turn inward. Put paste on bottom of flaps. Set cylinder so that flaps have their paste side down on the 4-inch square. Cut away protruding surface of square. Mother Bear's Bowl 2″ high is made.

LESSON XX

Baby Bear's Bowl—Rulers: 12″2″1″.

Material: Strip of paper 12″x2″; a 4-inch square.



On left and right edges measuring from upper edge make marks *a, b* with 1-inch ruler. Draw line *a-b* with 12-inch ruler. Fold so that bottom edge touches line *a-b*. Cut on fold. Compare the oblong cut off to large surface. Relation 1 to 3. Fold on line *a-b*. Make vertical cuts up to line *a-b* on oblong *c* for flaps. Paste right edge on left edge, turning flaps inward. Put paste on bottom of

them, set on 4-inch square and cut off protruding part of square. Baby Bear's Bowl is 1″ high.

If baby's bowl contains a pint of porridge, what does papa's contain (3 pints)? What does mamma's contain (2 pints)? The child cannot say 1 quart, unless you have had the actual quart and pint measurements in your room and he has measured and found out that a quart equals two pints.

The child should deal with the actual measures first. Then after he has seen the relations, let him draw inferences, by applying those relations in other ways.

For instance: When we made a bowl for the baby bear, and another with twice its capacity for the mother bear, we did not make them with the actual capacity of a pint and quart. But we may assume that the baby's holds a pint. Then the child infers that the mother's (having twice the capacity) holds a quart, because he has previously discovered through actual measurement that a quart is twice as much as a pint.

LESSON XXI

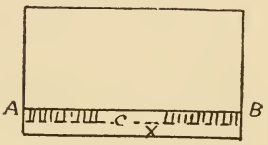
PAIL FOR JACK—RULERS: 9″5″4″1″.

Material: Pretty colored paper 9″x5″; a 3-inch square.
Number relations seen:

5	4	4	9	9	5	5
4	1	4	−5	−4	−4	−1
9	5	1	4	5	1	4

−

9

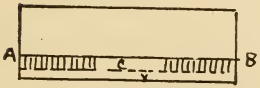


On left and right edges, measuring from upper edge with 4-inch ruler make marks *a, b.* Draw line *a-b.* Fold so that lower edge touches line *a-b.* Cut on fold. Now fold on line *a-b.* Make little vertical cuts on oblong *c* free-hand about ¼ of an inch apart up to line *a-b.* Paste right edge on left one, flaps turning in. Put paste on bottom of flaps, lay on 3-inch square and cut away part of square which is left on the outside. Use first strip *x* which was cut off as a handle for Jack's pail.

LESSON XXII

Jill's Pail—Rulers: 9″3″2″1″.

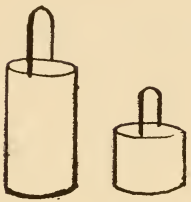
Material: Pretty colored paper 9″x3″; a 3-inch square.



Lay 2-inch ruler on left and right edges respectively from upper edge.

Make marks *a, b* and draw line *a-b.* Fold so that lower edge touches line *a-b.* Cut on fold. Use this strip *x* for handle. Fold on line *a-b.* Cut *c* into flaps. Paste right edge on left one, turning flaps in. Put paste on bottom of flaps and paste the cylinder on to the

3-inch square. Cut off protruding parts of square. Paste on the handle. Jack's pail is 4″ high. Jill's pail is 2″ high. Compare volumes. If Jill's holds a quart of water, Jack's holds 2 quarts.



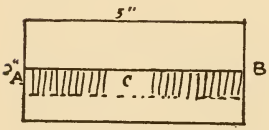
If Jack's holds a gallon of water, Jill's holds ½ of a gallon. If Jill's holds a pint of water, Jack's holds 2 pints or 1 quart (if children have had pint and quart measurements).

If a pint costs 3c, what does a quart cost? (2′ 3c or 6c) etc.

LESSON XXIII

Fox's Dish—Rulers: 5″2″1″.

Material: Paper 5″x2″; a 2-inch square.



Using 1-inch ruler make marks *a, b*. Draw line *a-b* with 5-inch ruler. Fold so that lower edge touches line *a-b*.

Cut on fold. Use pieces of this strip to make side handles for dish when it is finished.

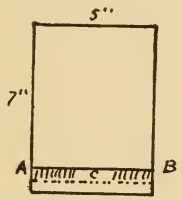
Fold on line *a-b*. Cut *c* into flaps. Paste right on left edges, flaps turning in. Put paste on bottom of flaps. Lay

cylinder flaps downward on 2-inch square. Cut off parts of square which project beyond cylinder.

LESSON XXIV

STORK'S DISH—RULERS: 5″7″6″1″.

Material: Paper 5″x7″; a 2-inch square.



Number relations seen:

5	6	6	7	6	7
1	1	−1	−1	−5	−6
6	7	5	6	1	1

Lay 6-inch ruler on left and right edges respectively. Make marks *a, b.* Draw line *a-b.* Fold so that lower edge touches line *a-b.* Proceed as in previous lesson to make the Stork's dish. Use strip cut off for side handles.

Relation of Fox's dish to Stork's dish is 1 to 6. If Fox's dish contains 1c worth of meat, what does Stork's contain? (6c worth.)

If Fox's dish contains 2c worth, what does Stork's contain? (6′ 2c worth or 12c worth.)

LESSON XXV

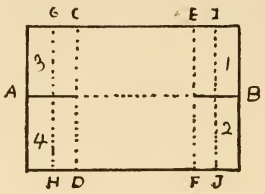
HANDBAG—RULERS: 9″6″3″2″1″.

Material: Paper 9″6″; also a strip 9″x1″.

Number relations reviewed—a great many seen, in comparing rulers and estimating length and width of paper.

9+3=6+6

6	2	3	2′3″=6″
3	1	2	3′2″=6″
–	–		3′3″=9″
9	3	1	
		–	
		6	



Lay 3-inch ruler on left and right edges respectively. Make marks *a, b;* draw line *a-b* with 9-inch ruler.

Lay 2-inch ruler on upper and lower edges, respectively, measuring from left edge make marks *c, d,* and draw the line.

Lay 2-inch ruler on upper and lower edges respectively, measuring from right edge; make marks *e, f* and draw line.

Lay 1-inch ruler on upper and lower edges respectively, measuring from left side; make marks *g, h,* and then draw line *g-h.*

Doing same on right side make marks *i, j,* and then draw line *i-j.*

Make cuts indicated at *a* and *b.* Fold on lines *c-d* and *e-f.*

Now fold back on lines *g-h* and *i-j.* Fold on line *a-b,* so that all these small folds are inside.

Paste oblongs 1 and 2 together.

Paste oblongs 3 and 4 together.

Cut the 9″x1″ strips into two equal narrow strips for handles—eye judgment only.

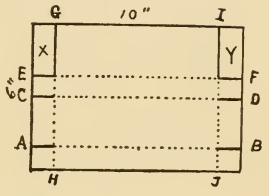
LESSON XXVI

PENCIL-BOX WITH LID—RULERS: 10″2″3″5″.

Material: Thin, smooth cardboard 10″x6″.

Number relations seen:

2	5	3	2′3″= 6″
3	5	3	3′2″= 6″
–	—		5′2″=10″
5	10	2	
		2	
		—	
		10	



Lay 5-inch ruler on left and right edges, measuring from upper edges; make marks *a, b* and draw the line.

Lay 3-inch ruler in same manner; make marks *c, d,* and draw the line.

Lay 2-inch ruler in same manner; make marks *e, f,* and draw the line.

Make marks *g, h,* with 1-inch ruler; draw line with long ruler.

Make marks *i, j* with 1-inch ruler; draw line with long ruler.

Cut out oblongs *x* and *y*.

Make cuts indicated at *a, b, c, d.*

Fold up and paste.

Surfaces can be compared by giving concrete problems as in former lessons.

LESSON XXVII

Match-safe

Colored smooth, thin cardboard 10″x4″ for back.

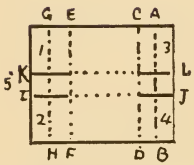
Colored smooth, thin cardboard 6″x5″ for box.

Sandpaper, 3″x2″.

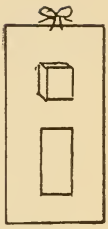
Rulers: 5″4″3″2″1″.

Let children estimate 10″ length of cardboard with these rulers. They will say:

5	5	4	3	4	3	2
4	3	3	5	4	3	2
1	2	2	1	2	3	2
—	—			—		
10	10	1	1	10	1	2
		—	—		—	
		10	10		10	2
						—
						10



On the cardboard which is 6″x5″, lay 5-inch ruler on upper and lower edges, respectively, measuring from left edge; make marks *a, b,* and draw line. Lay 4-inch ruler in same way; make marks *c, d,* and draw line. Lay 2-inch rule in same way; make marks *e, f* and draw line. Lay 1-inch ruler in same way; make marks *g, h* and draw line.



Lay 3-inch ruler on left and right edges, respectively, measuring from upper edge; make marks *i, j* and draw line.

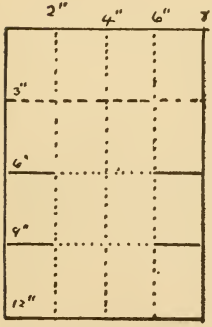
Lay 2-inch ruler in same way; make marks *k, l* and draw line.

Cut out oblongs 1, 2, 3, 4. Make cuts indicated at *i, j, k, l.* Fold and paste into box shape.

Paste box and sandpaper on large cardboard—spacing agreeably.

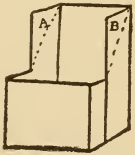
LESSON XXVIII

WOOD-BOX—RULERS: 3″6″9″12″—2″4″6″8″.



Material: Stiff paper 8″x12″. Using 2″4″6″8″ rulers to divide the short edges into 4 equal parts, gives a good review of number relations found in Lessons XIII and XVI.

Using 3″6″9″12″ rulers to divide long edges into 4 equal parts gives a review of number relations found in Lessons XII and XV. Make cuts indicated in Fig. 1.



Fold and paste into box shape. (Fig. 2.)

Cut on dotted lines *a* and *b*. In comparing surfaces and lines, speak of cost of coal or wood. Use the words "ton of coal," "cord of wood." They hear measurement words used in connection with things which require those measures.

LESSON XXIX

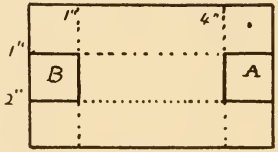
SLED—RULERS: 5″4″3″2″1″.

Material: Paper 5″x3″.

Number combinations seen:

3	2
1	2
1	1
–	–
5	5

etc.



2	3	4	3
1	1	1	2
–	–	–	–
3	4	5	5

Make vertical dotted lines with 4-inch and 1-inch rulers, respectively, measuring from left edge. Make horizontal dotted lines with 2-inch and 1-inch rulers, respectively, measuring from the top.

Cut out rectangles *a* and *b*.

By folding back rectangles formed by dotted lines there are surfaces to compare which show the relation 1 to 2; 1 to 3; 1 to 4.

Play these rectangles are sidewalks covered with snow to be shoveled. If a boy can shovel this (pointing to small surface) in 1 hour, how many hours will it take him to shovel this (pointing to the opposite surface). Result de-

pends on the surfaces which the teacher is comparing, of course. Suppose relation to be 1 to 2. (Ans. 2 hours.)

If he shovels the small walk in 2 hours, he can shovel the large one
in 2×2 hours, or 4 hours.
in 2×3 hours, or 6 hours.
in 2×4 hours, or 8 hours.
in 2×5 hours, or 10 hours.
in 2×6 hours, or 12 hours.

Many children will be able to give these results on account of former experiences with single unit rulers.

LESSON XXX

PUSHCART—RULERS: 7″5″4″1″2″.

Materials: Stiff school paper 9″x6″.

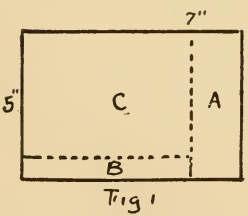


Fig 1

Ask children how long and wide the paper is without using any ruler. They have handled the 9-inch and 6-inch rulers so often that they ought to know how they look by this time.

Now tell them to measure the length with the rulers which they have. They learn that the sum of the 7-inch and 2-inch rulers equal 9″; that the sum of the 5-inch and 4-inch equal 9″.

In measuring the width they learn that 5″ and 1″ equals 6″; that 4″ and 2″ equals 6″.

Cut on dotted line drawn between marks made on upper and lower long edges with 7-inch ruler.

The rectangle *a* is now 2″x6″. With the 2-inch and 4-inch rulers divide this into 3 2-inch squares.

Cutting off the corners of two of these squares in a curved line gives two circles to be uesd as wheels. Cut remaining square into two equal pieces to be used as supports for the axles, which are toothpicks.

Fig 2

Now cut on dotted line, which is drawn between marks made on right and left edges with 5-inch ruler.

Cut rectangle *b* (Fig. 1) into two equal narrow strips to be used as shafts. From *c* (7″x5″) the box shape is made. (Fig. 3.)

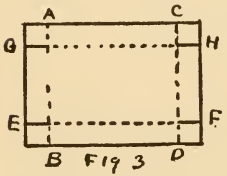


Fig 3

With 1-inch ruler make marks *a, b* on upper and lower edges, measuring from left side. Draw line *a-b*. With 1-inch ruler make marks *c, d* on upper and lower edges, measuring from right side. Draw line *c-d*.

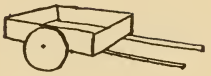
With 4-inch ruler, measuring from top on the left and right edges, make marks and draw line *e-f*.

With 1-inch ruler, measuring from top, make marks on left and right edges and draw line *g-h*.

Make cuts indicated at *e, f, g, h*.

Fold and paste into box shape.

Paste the little supports for the axles on the under side of the box after the axles have been laid in place. Put on the wheels and paste on the shafts. (Fig. 4.)



In comparing lines and surfaces in this lesson, base concrete problems on roads, trees, houses, stores or parks; things which the banana-man sees when he pushes his cart through the streets. Ask about time or number of men required or material needed to pave or sprinkle roads; to cut or sprinkle grass in the park; to plant trees in a row. Ask about amount of houses of equal size which can be built on compared surfaces.

LESSON XXXI

GOCART—RULERS: 2″4″6″8″.

Material: 2 sheets of stiff paper, one 10″x8″; the other 8″x6″.

In estimating length of paper new number combinations seen are:

8	6
2	4
—	—
10	10

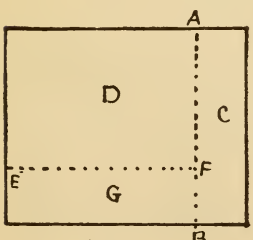


Fig 1

Some children ought to know that the paper is 10″ long, for they talked about 10″ in Lessons XXVI and XXVII.

Measuring on upper and lower long edges from left side with the 8-inch ruler on the large paper, make marks and draw line *a-b*.

Cut on dotted line *a-b*. Compare *c* to *dg*, with questions about material and cost of material for doll quilts and mattresses.

From *c* measure and cut 4′2″ squares, using the 6″4″2″ rulers. From these squares cut free-hand the four wheels, keeping them 2″ in diameter.

Measuring on left and right edges of 8″ square from the upper edge with the 6-inch ruler make marks, and draw line *e-f*. Cut on line *e-f*. From *g*, four equal long narrow strips are to be cut. Two of these, to be used for the handle, need a 2-inch mark at one end of each.

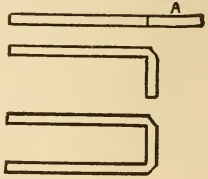


Fig 2.

Fold so that line *a* (Fig. 2) touches this mark.

Place short-folded parts of these strips together and paste, forming handle. (Fig. 2.)

Mark other two strips as indicated in Fig. 3.

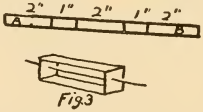


Fig 3

Fold on marks. Paste *a* on *b*. These are the springs to be pasted under the box-shape when it is made, putting toothpicks through the inch square sides of the springs for axles.

To make box-shape use *d*. (Fig. 1.) It is 8″x6″.

Measuring with 6-inch ruler on upper and lower long edges from left edge make marks and draw line *a-b*. In same way using 2-inch ruler draw line *c-d*. Measuring with 4-inch ruler, on left and right edges from upper edge, make marks and draw line *e-f*. In same way using 2-inch ruler draw line *g-h*.

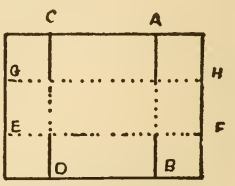


Fig 4

Make cuts indicated at *a, b, c, d.* Fold and paste into box-shape.

This is enough for one lesson. Next day give other piece of paper 8″x6″ to children. Make another box shape from it like Fig. 4. Compare volumes of these two which are equal.

When mamma goes marketing she takes baby with her in the go-cart. If one volume holds a peck of potatoes, the other holds a peck of potatoes.

If one holds half a peck of apples the other holds half a peck of apples. If one holds 5 pounds of sugar, the other holds 5 pounds, etc.

Now stand last box up on end and inside of the first box which has the springs and axles under it. Put on the wheels and paste on the handle.

LESSON XXXII

CRADLE—RULERS: 1″9″5″4″.

Materials: 2 sheets of stiff paper 10″x16″. 1 sheet of stiff paper 12″ square.

Use one sheet of the paper, 10″x6″, first.

In estimating length, get new relations:

9	5
1	4
10	1
	10

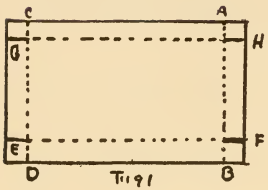


Fig 1

Measure on upper and lower edges, from left edge with 9-inch ruler; make marks and draw line *a-b*. Repeat with 1-inch ruler, and draw line *c-d*. Measure on left and right edges from upper edge with 5-inch ruler; make marks and draw line *e-f*. Repeat with 1-inch ruler and draw line *g-h*. Make cuts indicated at *e, f, g, h*. Fold and paste into box shape.

Take other sheet, 10″x6″. (Fig. 2.)

Measure on upper and lower edges from left edge with 4-inch ruler; make marks and draw line *a-b*. Measure on upper and lower edges again with 4-inch ruler, but measure from points *a* and *b* instead of left edge; make marks and draw line *c-d*. Cut on dotted lines *a-b* and *c-d*. Compare rectangles, calling them rugs. Compare sides of rectangles by asking questions about length and price of fringe.

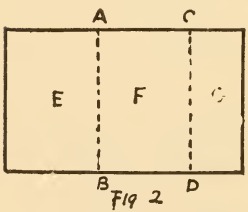


Fig 2

Fold so that each rectangle is folded into 4 equal parts; folding long edges so that they meet in each instance. The two larger rectangles *e* and *f* (they look like Fig. 3 now) are to be fashioned into rockers, after they are pasted in place under the box-shape.

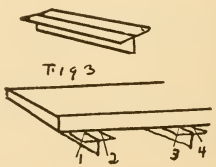


Fig 3

Cut off the protruding flaps indicated at 1, 2, 3 and 4.

Slope bottom edge of vertical surface to look like rockers.

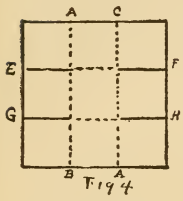


Fig 4

Cut *g* into strips and use them as braces to keep rockers in place.

Next day make another box shape out of the 12-inch square thus:

On upper and lower edges, measuring from left edge with 4-inch ruler, make marks and draw line *a-b* (Fig. 4), using same ruler on same edges, but measuring from right edges draw line *c-d*.

Same ruler on left and right edges measuring from upper edge, draw line *e-f*.

Same ruler, same edges, measuring from lower edge, draw line *g-h*.

Make cuts indicated at *e, f, g, h*. Fold and paste into box shape. Compare this volume to the one made yesterday. Relation 2 to 1. If one holds a quart of beans the other holds ½ of a quart.

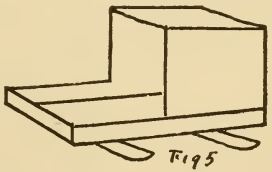


Fig 5

If one quart costs 10c, ½ quart costs ½ of 10c, or 5c.

If one quart costs 12c, ½ quart costs ½ of 12c, or 6c, etc.

Set large volume on one end inside the other one. (Fig. 5.)

LESSON XXXIII

Bureau—Rulers: 3″6″9″12″—1st Day

Material: 1st day, 12-inch square of stiff paper.

Divide 12-inch square into 16 small squares, using the 3″6″9″ rulers. Cut, fold and paste into box shape, having dimensions 6″x6″x3″.

Material: 2nd day, stiff paper 10″x7″.
Rulers: 8″2″5″.
Number relations seen: 8 5
2 2
— —
10 7

Lay 8-inch ruler on upper and lower edges, measuring from left edge; make marks and draw line *a-b*. (Fig. 1.)

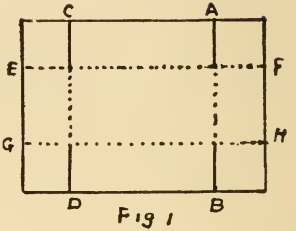


Fig 1

Lay 2-inch ruler in same way; draw line *c-d*.

Lay 2-inch ruler on left and right edges, measuring from upper edge; make marks and draw line *e-f*. Lay 2-inch ruler on same edges, but measure from lower edge, and draw line *g-h*.

Make cuts indicated at *a, b, c, d*. Fold into box shape; dimensions 6″x3″x2″. Make two more boxes with dimensions 6″x3″x2″. Compare their volumes to each other and to the large one made the first day. Relation 1 to 3. The small box shapes are drawers to be slid into large frame 6″x6″x3″. If one drawer holds 3 tablecloths, how many will the whole bureau hold? (Ans. 3′3 tablecloths, or 9 tablecloths.) If the tablecloths in one drawer cost $4.00, how much does the bureau full cost? (Ans. 3′$4.00, or $12.00.)

If they cost $2.00? (Ans. 3′$2.00, or $6.00.)

Slide the drawers into the frame. Give the children an-

other small piece of the paper. From this let them make a back for the top free-hand; also the handles for the drawers. Silver paper is a very good play substitute for glass, if the children care to have a mirror at the top. Put on extra legs at bottom if desired, making them like tiny square prisms.

LESSON XXXIV

A Chiffonier

Rulers: 10″2″8″; 2″4″6″.

Material: 1 sheet stiff paper 12″x10″.
4 sheets stiff paper 8″x 6″.
1 sheet stiff paper 6″x 6″.
1 sheet stiff paper 10″x 8″.

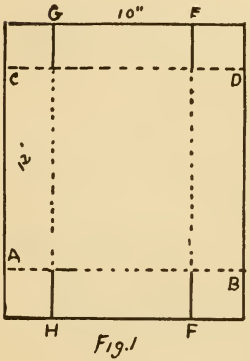


Fig. 1

Make line *a-b* with 10-inch ruler, measuring from top of paper, which is 12″x10″. (Fig. 1.)

Make line *c-d* with 2-inch ruler, measuring from top.

Make line *e-f* with 8-inch ruler, measuring from left.

Make line *g-h* with 2-inch ruler, measuring from left.

Make cuts indicated at *e, f, g, h.* Fold and paste into box shape. Large frame is made. (Fig. 1.)

Make line *a-b* (Fig. 2, paper 8″x6″) with 6-inch ruler, measuring from left. Use 2-inch ruler same way to make line *c-d*.

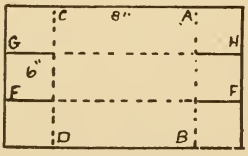


Fig. 2

Use 4-inch ruler to make line *e-f,* measuring from top.

Use 2-inch ruler same way to make line *g-h.* Make cuts indicated at *e, f, g, h.*

Fold and paste into box shape. Make four of these. They are the four drawers to the right. From 6-inch square make a 2-inch cube with one side open, using 2- and 4-inch rulers. This is the little drawer for the upper left-hand corner.

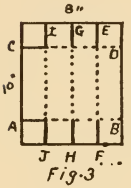


Fig. 3

Use 8-inch ruler to get line *a-b*, measuring from top. (Fig. 3.) Use 2-inch ruler same way to get line *c-d*.

Use 6-inch ruler, measuring from left, to get line *e-f*.

Use 4-inch ruler same way to get line *g-h*.

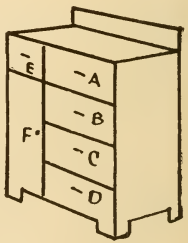
Use 2-inch ruler same way to get line *i-j*.

Cut out upper and lower left-hand corners.

Make cuts indicated at *e, f, g, h*.

Fold and paste into square prism shape. The side which has three free edges is the door of the cupboard. (Fig. 4.)

Make legs and mirror back as in previous lesson if desired.



Compare volume of *a* and *b* (equal).

Compare volume of *e* and *a* (1 to 2).

Compare volume of *e* and *f* (1 to 3).

Compare volume of *e* to sum of *a* and *b* (1 to 4).

Compare volume of *e* to sum of *f* and *d* (1 to 5).

Compare volume of *f* to whole frame before any drawers were put into it (1 to 4).

Compare volume of *a* to volume of large frame (1 to 6).

If *e* holds two of baby's dresses, *a* holds 2 times 2 dresses, or 4 dresses; *f* holds 3 times 2 dresses, or 6 dresses; the sum of *a* and *b* holds 4 times 2 dresses, or 8 dresses; the sum of

a, b, and *c,* holds 6 times 2 dresses, or 12 dresses; the sum of *a* and *f* holds 5 times 2 dresses, or 10 dresses, etc.

In this lesson the children handled the rulers 2″,4″,6″,8″, 10″, and one of the papers was 12″ long. They have dealt with this length so often that they know it, even though the 12-inch ruler is not in their hands.

They saw that:

2′2″= 4″	6′2″=12″
3′2″= 6″	2′4″= 8″
4′2″= 8″	2′6″=12″
5′2″=10″	

They also saw the combination, separation and division of these number facts.

LESSON XXXV

A Large Envelope

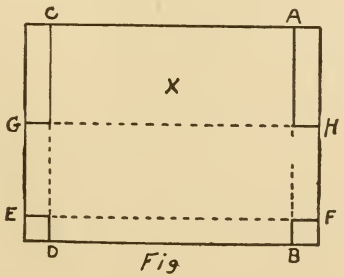
(To hold weaving strips, or braids of cord or raffia until they are needed.)

Rulers: 11″1″8″4″.

Material: 2 sheets manila paper 12″x9″.

New numerical values seen: 11 8

$$\frac{1}{12} \quad \frac{1}{9}$$



Fig

Make line *a-b,* measuring from the left with the 11-inch ruler. Make line *c-d* in same manner, using 1-inch ruler to make marks *c-d* and long ruler to draw line.

Using 8-inch ruler, measuring from top, make line *e-f.*

Using 4-inch ruler, measuring from top, make line *g-h.*

Cut out corners. Compare them to each other, giving problems. Fold on dotted lines.

Next day use the other sheet of manila paper and rulers 2″4″5″10″. Numerical values seen:

2×5″=10″ 10″
5×2″=10″ 2″
—
12″ (paper is 12″ long)

5″
4″
—
9″ (paper is 9″ wide).

Measuring from left with 10-inch ruler, make line *a-b.* (Fig. 2.) Cut on line. Compare the two surfaces, giving problems on varnishing table tops. (Relation 1 to 5.)

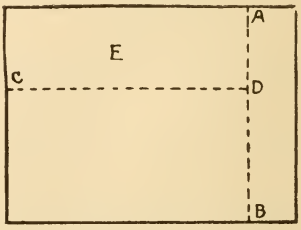


Fig 2

Measuring with 4-inch ruler from top, make marks and draw line *c-d.*

Paste surface *e* on folded over flaps of Fig. 1, leaving *x* for cover flap.

LESSON XXXVI

Book for Cuttings: Unfolded Sheets

Rulers: 1″3″6″9″.

Materials: 10 sheets grey paper, 6″x9″; 1 sheet grey or colored paper, 9″x12″; 1 sheet manila or colored paper, 6″x9″. Fifteen inches of cord, raffia or ribbon for lacing.

Numerical relations seen:

3′1″=3″ 2′3″=6″

6′1″=6″ 3′3″=9″

9′1″=9″

On each of the 10 sheets 6″x9″ to be used as leaves, make dots *A* and *B* measuring with 1-inch ruler from the upper and lower left-hand corners (Fig. 1).

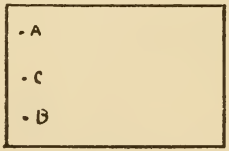


Fig. 1

Make dot *C*, using 3-inch ruler.

Punch holes where the dots are.

To make the cover, use the grey or colored paper, 12″x9″ (Fig. 2).

With the 6-inch ruler make marks *A*, *B*. Draw line and cut. Compare the two surfaces, giving problems on amount and cost of paper, linen or leather for book covers. (Relations 1 to 2).

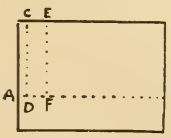


Fig 2

Measuring with 1-inch ruler make line *C-D*. Measuring with 3-inch ruler make line *E-F*.

Fold left edge to meet line *C-D*.

Cut on fold. Now fold on line *E-F*.

Using 1-inch and 3-inch rulers, as for pages, make dots *A, B, C,* and punch holes. To make decorations for cover, use manila paper, 6″x9″. (Fig. 3.)

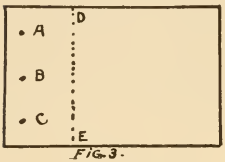
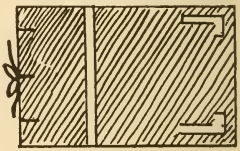


FIG. 3.

Measuring with 3-inch ruler from left edge, make marks and draw line *D-E.*

Cut on line. Compare the two surfaces. Using 1-inch and 3-inch rulers, make dots and punch holes as before. This piece of paper slips under the flap of the cover.

Use the 6-inch square which is left for any additional decoration desired. It can be cut into four equal oblongs. Bisect one of them and cut the pieces diagonally; use them to strengthen corners. Or, cut the pieces so that by making a cut $\frac{1}{4}$ way down on the long edge and $\frac{1}{4}$ way across on short edge, a corner is removed. Or, the pieces can again be bisected, making little squares, which can be cut in many ways. Another pretty decoration is the word "Cuttings" cut free-hand by the child, then pasted on the cover.



Lace the book in any desired way.

LESSON XXXVII

Book With Folded Leaves for Words

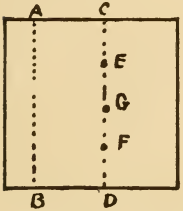
Rulers: 6″1″7″.

Material: Six 7-inch squares of white, smooth paper; one 8-inch square of cover paper.

Sew together with cord 12″ long. New combination seen:

6
1
—
7

On each of the six squares of white paper draw the line *a-b*, using the 1-inch ruler. Cut on the line. These narrow strips can be utilized later in a weaving lesson. Compare them with the large surface. Now fold each of these large surfaces so that their long edges touch, or use a 3-inch ruler to get the dividing line *c-d*.



Measuring on this line from top and bottom, with 2-inch ruler make dots *e*, *f*. Half-way between these dots (eye judgment only) make another one, dot *g*. These are necessary only on the page which will be the center of the book, so the child can see where to place the needle.

Fold the 8-inch cover paper into two equal oblongs.

With the 2-inch ruler make dots as at *e* and *f*. Place center dot also. Sew and decorate cover in any desired way

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